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COLONIAL DEVELOPMENT AND WELFARE

THE full statement which the Minister of Food, Mr. Strachey, made in the House of Commons on the East African groundnut scheme on March 14 did not dispose of some of the criticism; on the whole, however, with some assistance from the Opposition, he succeeded in putting the scheme in its true perspective in terms of Colonial development. The public has hitherto regarded the scheme as essentially one to produce oils and fats, for which the fact that the Minister of Food was made responsible for the scheme was undoubtedly a contributory factor. The scale of the scheme is now to be reduced; but Mr. Strachey rightly refused to regard the production of oils and fats as unimportant. The world need of fat supplies is as great as ever, and whether or not the revised scheme will give, as is claimed, the same yield of oils and fats, the importance of that aspect remains, even if it is secondary to the main purpose of Colonial welfare and development.

Mr. Strachey stated that the acreage to be cleared in the three East African areas is to be reduced from three and a half to two millions, and that the Overseas Food Corporation estimates that, working to the ten-year plan, the new acreage will give the 600,000 tons of oil-seeds originally forecast. A higher yield would be made possible by including sunflowers in the rotation of crops. Development of the Kangwa area, where practically all the clearance has so far been done, will be restricted in favour of the more promising western area of Urambo and the southern area of Tanganyika; but Mr. Strachey advanced no evidence that better preparation has been made in the southern area, where admittedly no clearing has yet been done.

On such technical points there was surprisingly little comment in the debate in the House of Commons; but such factors will have a very important bearing on the expenditure involved. It was admitted by Mr. Strachey that the cost of the scheme may well be double the original estimate. That estimate may be accepted; but there will be less confidence in his estimate that revenue will also be doubled. Inflation has greatly exaggerated the world shortage of fats, and informed opinion is at least doubtful whether the price of groundnuts is likely to remain at the level of £51 a ton which the Ministry of Food is at present paying in its long-term contract for main supplies from West Africa. That price represents an increase of £6 a ton on the 1947–48 price, and, to say the least, it is unreasonable to expect the British taxpayer to permit the Minister of Food indefinitely to pay an inflated price in long-term contracts and ignore any fall in world prices.

Nevertheless, whatever the financial shortcomings of the scheme, Britain is now committed too deeply for it to be abandoned unless it is proved to be impracticable agriculturally. The best opinion is against so pessimistic a conclusion, and the reforms announced by Mr. Strachey appear to be sound. The revised plan will, however, require vastly improved methods of organisation if it is to succeed,

and Mr. Strachey did not conceal the problems which are presented by such matters as stores, tractors and other equipment, and port and railway extensions. Much careful planning and preparation are needed, for these matters are not without bearing on other economic developments, as Mr. Strachey indicated in relation to the railway developments in the Lukeledi valley, which are to provide an outlet to the new port of Mikidani from the groundnut area.

The scientific and technical factors were chiefly stressed in the debate by Mr. Henderson Stewart, who rightly directed attention to the time required to be certain we had found the right solution to problems of cultivation, agricultural implements, the rotation of crops, fertilizers and so on. This speech drew from Mr. Strachey a repudiation of any suggestion that the Government had attempted to drive the Corporation or the managing agency at an unreasonable speed. But it must be recognized that long-term and short-term requirements are not always compatible; the Government has tended hitherto to overstress the short-term aspect of the scheme, and its reluctance to provide a report or 'white paper' in advance of the debate has not made it easy to correct that impression.

Two things at least the debate has done. From all sides of the House, members joined with Mr. Strachey in commending the personal devotion and enterprise of the Europeans working on the scheme in East Africa, and the debate should dispel any lingering ideas that criticism of the scheme should be levelled against those responsible for its execution in Africa. It was, indeed, suggested that the proportion of Europeans to Africans engaged in the scheme is considerably higher than originally envisaged—one to eleven instead of one to every thirty or forty Africans—and concentration of the Europeans on scientific, technical and supervisory tasks to the maximum extent should reduce the administrative and overhead costs. Mr. Frederic Harris also suggested that splitting up the 30,000-acre units into units of 5,000–8,000 acres for private development was a sensible proposition which should also be tried.

Above all, the debate brought out the welfare aspect of the scheme. The Minister of Food spoke of the benefit which would accrue to the African peoples once the project is fully under way; already, he said, there is evidence of benefit to health through the improved nutrition of those participating in the scheme. He might, indeed, have said more about the difficulties of maintaining a steady labour force and the measures that will be required to overcome them. Nevertheless, it can no longer be pretended that the scheme is one of exploitation of African resources for the benefit of the rest of the world; it is essentially a long-term development scheme in which the primary purpose is Colonial welfare, while simultaneously serving the world's needs for oils and fats.

The welfare aspect must, indeed, be kept in mind if the economic aspects of the scheme are to be considered fairly, whether from the point of view of the Colonial people or of the British taxpayer. The debate is one, therefore, to be considered in the context of a subsequent debate on Colonial policy and administration in the House of Lords on April 13. Against this background, too, should be reviewed the recent reports from the Colonial Office on the production of fish in the Colonial Empire and on the work of the Colonial Primary Products Committee. A large part of the latter report, in fact, deals with vegetable oils and oil-seeds and with essential oils, and in introducing the report the Committee refers particularly to the bearing of price, particularly on the production of oil-seeds.

Before the Second World War, the primary producer was often penalized by fluctuations in commodity prices on world markets. Marketing schemes established during the War for various Colonial products often paid producers a fixed price for the whole season, and producers of annual crops were guaranteed prices for their produce before the planting season began. Since the assurance of a reasonable price tends to encourage the planting of annual crops, continuance of such schemes, suitably modified, should increase production; and the system has the further advantage that central organisation can accumulate funds at times of high prices and subsidize prices paid to producers when world prices fall, thus cushioning producers to some extent. The Colonial Primary Products Committee in its report welcomes the policy of long-term contracts pursued by the Government, particularly for tree crops and where capital development is involved. Quoting the text of the statement made by the Chancellor of the Exchequer on September 17, 1948, in regard to such guarantees for Colonial produce, it suggests that similar considerations might govern the conclusion of contracts for commodities bought by other control buying organisations or associations of users or manufacturers.

It does not appear, however, that Mr. Strachey has yet fully appreciated the implications of the Chancellor's observations on price, or on the imperative need for establishing beyond question community of interest and co-operation if misunderstandings are not to arise and justice is to be done between the primary producer and the ordinary citizen of Great Britain. Moreover, as the Colonial Primary Products Committee has noted, where a crop such as oil-seeds in West Africa is largely a cash crop, high prices will not result in increased production if there is a shortage of consumer goods. Lord Swinton did well to explain, in opening the House of Lords debate, the interdependence of economic prosperity, health and practical education in the Colonial areas, and the way in which the needs of the Colonial peoples are linked with the needs of people in Britain.

The commodity studies presented in this second report from the Colonial Primary Products Committee are reviewed elsewhere (p. 898 of this issue); it is sufficient here to note that the Committee takes the view that semi-mechanized methods for the cultivation of such crops as groundnuts and sunflowers are unlikely to be introduced rapidly into West African territories. It will probably be necessary to start with pilot schemes, the results of which must be available before production can begin on a larger scale. Similarly, experiments on a large scale over a period of years will be required before any

sound conclusions can be reached as to the possibilities for groundnuts in British Honduras.

The improvement of material conditions must clearly come first, and the debate in the House of Lords brought out the need for a coherent and consistent policy in Colonial administration. Without that, neither British nor Colonial scientific workers, even with the help of American technical experts, will secure the physical development of mineral wealth or other natural resources, water supplies or transport, or the improvement in health and social welfare which could follow the application of advances in knowledge of nutrition, preventive and curative medicine and the like. There must be a balance between such measures and those taken in the economic and political field.

Lord Swinton, at the outset of his speech, enunciated five principles which should guide British Colonial policy and the planning of Colonial development. First, we are trustees for the whole of the Colonial peoples and not for a section or a minority. Secondly, the primary need of all these peoples is improved health and well-being, and the true liberty of the individual to enjoy them. Thirdly, economic and social progress depends on co-operation between the European and the indigenous populations. Fourthly, the ultimate goal is self-government, the evolution of which may be infinitely varied ; and last, that the prerequisite of self-government is the capacity to govern.

These five points were accepted on behalf of the Government both by Lord Pethick-Lawrence and by Lord Listowel. Nevertheless, there remains some doubt whether in practice the tempo of political development is quite in keeping with the first and last points, and whether there is not danger that too much regard is being had to the demands of a more vociferous minority. As Lord Swinton said in amplifying his last point, without effective government there can be no freedom for the individual, and while all suffer, the ordinary man suffers most.

It will not, and cannot, be easy to arrive at a balance which will satisfy all, and the balance must be struck for each territory in the light of the circumstances which prevail there. The Colonial Office tends to be over-cautious and, although sections of the local population may be over-eager or over-sensitive in the matter of political independence, the Colonial Office must none the less show more imagination and the leadership which inspires confidence. The points made by Lord Swinton provide some guide in working out a practical policy, particularly when three important points stressed by Lord Tweedsmuir are also remembered. Political independence can only come about when economic independence has been secured, and only then when the capacity for government exists. In all African Colonies and in many others, the Colonial peoples cannot make headway at present without European leadership, and European capital and technical help ; and that help will count for nothing unless we can take some Colonial peoples along with us in partnership. The second of those points was strikingly emphasized by Dr. C. H. Northcott in his recent report on the efficiency of African labour.

Hence Great Britain has still a great part to play in the future of the Colonial peoples, and it is important that at the centre there should be clear and constructive leadership, and that malicious criticism frequently levelled against Great Britain and other Colonial Powers should receive a positive answer. The United Nations Scientific Conference on the Conservation and Utilization of Resources meeting this summer at Lake Success will provide emphatic evidence of the British contribution to Colonial welfare. An even more important contribution of the Conference may be in furthering both the indispensable co-operation between the Colonial Powers and the Colonial peoples, and in shaping regional and other forms of co-operation between the Colonial Powers which will enable scientific and technical advances to be brought most swiftly and effectively to bear on the economic and social problems of the Colonial peoples. Nothing in Lord Listowel's reply was more welcome than his recognition that education is the vital social service, and that teaching people to govern themselves in local communities provides the real basis of political advance.

PROBLEMS OF ORGANIC FORM

Organic Form and Related Biological Problems

By S. J. Holmes. Pp. vii+169. (Berkeley and Los Angeles : University of California Press ; London : Cambridge University Press, 1948.) 27*s*. 6*d*. net.

THE title of this book is aptly descriptive of the contents. In a series of related essays, the author has discussed the factors which determine form in living organisms. It is difficult to do justice to a work such as this in a short review, for the author has succeeded in saying so much, and that with an illuminating perspicacity, that is cogent in each of his condensed chapters. These are concerned with an inquiry into the problem of organic form, the functional aspect of morphogenetic processes, competition as an integrative factor in morphogenesis, differentiation, chemical equilibrium and organic integration, and so on. On each theme, the leading ideas that at one time or another have been held are clearly set out, and an attempt is made to find a sure way to explanations of a valid kind. In these discussions the author's fairness and balance are a striking feature ; his contribution is patently the result of long and deep pondering of central themes in contemporary biology.

In every normal embryonic development the impressive facts are the formation and divergent development of the component parts or organs, their regular appearance in their proper positions, and the regulation and harmony of morphogenetic processes that result in the characteristic development of the whole. How are these phenomena to be explained, and what kinds of explanation are likely to prove acceptable to the contemporary biologist ? On such problems much new light is shed by the analytical approach adopted in this work. In the author's view, morphogenetic and related processes can be referred to biochemical and biophysical processes which are ultimately gene-controlled, that is to say, an epigenetic and mechanistic view of formative processes

in plants and animals is upheld, the genes themselves being seen in relation to the evolutionary background. As a sample of the author's style, reference may be made to his chapter on "Genes *versus* Gradients": "If a viable organism is to be made, its parts must be of the right kind, in the right place, and appear at the right time. If oaks, oysters, grasshoppers, and elephants all owe their initial patterns to their metabolic gradients, we must look to other factors to account for the marvellously co-ordinated processes that give rise to these very different styles of organic structure." The decision is heavily in favour of the genes as the physiological agents chiefly involved: "As more becomes known about the relative roles of genes and cytoplasm in heredity and developmental physiology, the more basic the influence of genes is found to be".

Other chapters deal with cancer as a biological problem, the idiosyncrasies of direct adaptation, autocatalytic enzymes and the origin of life, and recapitulation and its supposed causes.

There can be no doubt that in these papers the author has made a significant contribution to modern biology. He has succeeded in giving a clear impression of the aims and outlook of the experimental biologist and in showing how adequate, on the whole, such an outlook can be.

SOUTH AMERICAN BOTANY

La vegetación del nordeste de la Provincia de Entre Ríos

Informe cientifico. (The Plant Cover of the North-east of the Province of Entre Ríos: Scientific Report.) Por P. G. Lorentz. Second edition. Pp. xi+180+xiii+3 plates. (Paraná: Talleres Gráficos Pattarone y Sors, 1947.)

Observaciones sobre la vegetación de la Provincia de Tucumán

(Observations on the Vegetation of the Province of Tucumán.) Por G. (J.) Hieronymus. (*Mon. Inst. Est. Geogr. Univ. Tucumán*, No. 5.) Second edition, revised and with critical notes by Hans Seckt. Pp. 162. (Tucumán: University of Tucumán, 1945.)

Esquisse de mes voyages au Brésil et Paraguay, considérés principalement sous le rapport de la botanique

(Sketch of my Travels in Brazil and Paraguay, with special reference to the Botany of those Countries.) Par A. de Saint-Hilaire. (*Chronica Botanica*, Vol. 10.) Pp. 61. (Waltham, Mass.: Chronica Botanica Co. London: Wm. Dawson and Sons, Ltd., 1946.)

THE work of the botanical pioneers in South America appeared for the most part in the form of pamphlets or monographs which soon became exhausted and inaccessible to later generations, or else it was published in equally inaccessible, obscure periodicals. Most of it was, however, work of great importance and the foundation upon which subsequent research, at all events for certain regions, has been built. For this reason the recent re-publication of some of the outstanding earlier work is a welcome addition to the botanist's armoury, and it is to be hoped that more will follow.

The last to appear has been P. G. Lorentz's classic report on the plant cover of the Argentine Province of Entre Ríos, first published in 1878 and now re-issued by the Municipal Cultural Commission of Paraná and the Museum of Entre Ríos at the decree of the Provincial Government. The reproduction is an exact one, without any kind of correction, and reflects faithfully the conditions under which Lorentz was working, conditions described also by J. R. Eáez, who writes the introduction and an appendix. Lorentz had the entire goodwill of the Argentine Government of his day and every material assistance that it was able to afford him; but the national exchequer had been so greatly impoverished as a result of revolution and counter-revolution that the botanist, fresh from the well-equipped universities of Germany, described himself as "a scientific Robinson Crusoe", lacking the most elementary scientific equipment and especially hampered by the lack of books. He was, in addition, dogged by persistent ill-health which cut his career short in 1881. But his affection for the country of his adoption was great and his enthusiasm for his work unbounded, so that, lecturing during term-time at the College of Concepción on the River Uruguay, and, accompanied by some of his students, exploring the countryside on horseback in the vacations, he assembled an enormous mass of material and information. Most of this is crystallized in the book now reproduced. When for lack of works of reference Lorentz was unable to classify plants himself, he sent them to Prof. Grisebach, of Göttingen, for identification.

The work has three chapters. The first (pp. 3–47) contains a general description of the flora of such of Entre Ríos as Lorentz had been able to explore up to 1876. This embraced the north-eastern part from Concepción northwards as far as the junction of the Rivers Mandisobi Grande and Mandisobi Chico, and part of the woodland known as the Montiel. Some of the account takes the form of a diary describing a tour made in 1876. Practically the only form of use to which the country was put in Lorentz's day was a haphazard type of stock raising; but he was impressed by the fertility of the land and foretold a great future for the Province if at least a part of it were devoted to cropping. This has now taken place, and photographs published by J. L. Rich in "The Face of South America, an Aerial Traverse" (New York, 1942) clearly display a land of well-watered plains or gently undulating land with rich black soils, a large proportion of which are occupied by various cultures.

The second chapter (pp. 49–102) lists 620 species of flowering plants and 32 fungi collected by Lorentz and identified by him or by Grisebach of Göttingen. Notes are given on habitat, popular name, flower colour or other salient characters, growth habit, time of flowering, and in some cases the uses of each species. The achievement was a remarkable one. Until the arrival of Lorentz in Argentina, said Holmberg as quoted by Eáez, the flora of that country consisted not of plant species but merely of grass and timber.

The third chapter (pp. 103–180) is entitled "Phytogeographical Relations" and compares the flora of Entre Ríos with that of the interior. For the interior, 100 families, 451 genera and 960 species are recorded, for Entre Ríos 98 families, 346 genera and 620 species. The flora of Entre Ríos is considered poor in relation to the geographical position, climate and soil of the Province, the poverty being attributed to the youth of the country. A list of 1,481 Argentine plant species is given (pp. 124–157), with notes of

their presence or absence and frequency in Entre Ríos, the interior *monte* or scrub forest and the sub-tropical parts of Argentina respectively, and the regional affinities and differences noted are discussed. The Entre Ríos flora is distinct and independent, constructed on the same plan as that of the *monte* and the sub-tropical regions, but with different elements. It would probably not be equally independent if compared with the flora of southern Brazil. Natural plant colonization in Argentina is principally from the north.

A contemporary of Lorentz in Argentina was another German botanist, Georg Hieronymus, who was professor of botany in the University of Córdoba; and the two collaborated in collecting and classifying a large amount of botanical material from Central Argentina. It is on the results of their joint work that many of Lorentz's conclusions recorded above were based. Like Lorentz, Hieronymus did not confine himself to the systematics of the Argentine flora, but was intensely interested in its distribution as governed by climatic and environmental conditions. He published in 1874 a treatise on the plant cover of the Province of Tucumán, which was the foundation of all subsequent botanical work on that region; but for many years it had become quite unobtainable for the ordinary worker and was difficult to find even in libraries. Its republication by the Institute of Geographical Studies of the Tucumán University, therefore, has satisfied a real need. Although its general terminology has been modernized by the reviser, H. Seckt, who has also supplied critical notes on Hieronymus's taxonomy, but without changing the names used, the work remains practically unaltered and is entirely pertinent to present-day conditions. An introductory chapter lists some fourteen different formations which make up the plant cover of Argentina generally, and those found in Tucumán are enumerated in the next chapter. Subsequent chapters give a detailed account of the different types of grassland found in the eastern plains of the Province, of marsh vegetation and water plants, of the different types of forest and woodland and their components (pp. 56–128), and finally of the mountain plant formations with no characteristic tree growth but a sward composed of grasses in association with shrubs and herbaceous plants. A map of the vegetation is appended, drawn in accordance with the formations as described by Hieronymus.

The third reprint to which attention is directed here is the reproduction in *Chronica Botanica* of the introduction to Auguste de Saint-Hilaire's great work on the plants of Brazil and Paraguay, published in 1824 and, according to Castellanos and Pérez-Moreau's bibliography of botanical works on Brazil (*Lilloa*, **7**, 431; 1941), the earliest study of the Brazilian vegetation except one published by Spix and Martius in 1823.

The area traversed by Saint-Hilaire in 1816–22 was small in relation to the whole, vast extent of Brazil; but it was representative and enabled him in this 37-page introduction alone to give a picture of most of the characteristic Brazilian plant formations and of the flora of Uruguay and the east of Paraguay. Before the advent of the French explorer practically nothing was known of the flora and fauna of these regions. Among interesting descriptions may be noted those of the typical Brazilian bush named *caatinga*, of the *sertão* or hinterland of Minas Gerais, and of the Uruguayan grasslands, of which he says: "Nowhere, perhaps, do better pastures exist". To Lorentz in Argentina the results of civil dissension were ever-present in the form of straitened means and the depleted animal population of Entre Ríos; to Saint-Hilaire in Uruguay and the La Plata region they were manifest in the amazing spread of weed growth and especially of the European *Cynara cardunculus*. Before the war which had just taken place, he wrote, the young shoots of this plant were eagerly grazed and the plant itself was prevented from spreading unduly, but with the war-conditioned destruction and loss of cattle all limiting influences were removed. "*Cynara cardunculus* to-day covers immense terrains; it makes them useless for cattle and horses and it will be an indestructible monument of the civil discords which have rent this fair country." It is only now, more than a century later, that Uruguay is beginning to see an end of this weed problem, one valuable solution being the cutting of *C. cardunculus*, *Silybum marianum* and similar weeds for silage. The silage produced is highly nutritive, and the cutting tends to clear areas of the undesirable plants and to make room for better (A. Boerger. "Investigaciones agronómicas." Vol. 2. Buenos Aires, 1943). An introductory essay by Anna E. Jenkins precedes the reproduction of Saint-Hilaire's work.

G. M. Roseveare

ADVANCES IN ELECTRONICS

Advances in Electronics

Edited by L. Marton. Vol. 1. Pp. xi+475. (New York: Academic Press, Inc.; London: H. K. Lewis and Co., Ltd., 1948.) 9 dollars.

THE "Reports on Progress in Physics" have always fulfilled a valuable function in acquainting the specialist in any one of the physical sciences with progress in cognate subjects. These "Reports" cover the whole range of physics, and it was felt that electronics, though a part of physics, so spilled over into electrical engineering and had grown to such a size that a volume of review articles confined to electronics was needed. Dr. L. Marton, now of the Bureau of Standards, has undertaken this task as editor, and the first volume has just been published. Although this is an American publication, it intends to draw freely upon European men of science for review articles, and already plans for volumes 2 and 3 include a number of British contributors. Volume 1 is written entirely by American men of science, but this was due to the difficulties encountered in launching the new venture.

In the preface, Dr. Marton points out that "Advances in Electronics" will be confined to the physics of electrons in the free state—emission, space-charge effects, interaction, etc.—and to the engineering applications of a fundamental character, avoiding so far as possible discussion on instrumentation and circuitry. The contents of volume 1 certainly bear out the policy he outlines.

Electron emission is dealt with in two long articles, A. S. Eisenstein on "Oxide Coated Cathodes", and K. G. McKay, of Bell Telephone Laboratories, Inc., on "Secondary Electronic Emission"; both are most exhaustively treated with what appear to be complete bibliographies over the past decade. Eisenstein's review brings up to date J. P. Blewett's 1939 résumé of the subject, and includes the important war-time research on cathodes in magnetrons and valves pulsed for times of the order of microseconds.

The results of this work focused attention on the importance of the interface between the base metal and the oxide layer, and a whole section of the review is devoted to our present knowledge of the interface and its probable rectifying properties. A further important section reviews the known properties of the complete cathode, and includes the probe experiments and the phenomenon of sparking, all of which have only been reported upon since the War. McKay divides his subject into emission from pure metals and emission from insulators, and includes a summary of early work, since the standard reference hitherto has been in German. It is interesting to learn how little modern work has been done on the velocity of emission of secondary electrons, a field obviously ripe for further exploration. Practically the whole of the long section of the emission from insulators is based on research published since 1939 and is of great importance.

R. G. Hutter contributes an original article on the deflexion of beams of charged particles, a subject which has received far less attention than the focusing of beams by lenses; he deals with single and double electric and magnetic deflexion, with large-angle deflexion, and with the many mixed deflexions in mass spectrometers. M. G. Inghram, of the Argonne Laboratory, supplements this with an article on mass spectroscopy, in which the use of the spectroscope is treated. It was surprising to find no mention of the calutron in an article on mass spectroscopy.

The television pick-up tube has become a third method of visual examination supplementing the eye and the photographic plate. Apart from use in the entertainment world, the television tube has an important future in the research laboratory, and men of science will turn to A. Rose's article on "Television Tubes and the Problem of Vision" to find out the ideal performance of tubes and the degree to which present-day tubes achieve this ideal.

The last article on particles is a review by M. S. Livingston on "Accelerators"; but for readers in Great Britain there is already a recent review in the current "Reports of Progress in Physics", which practically covers the ground.

The importance and fickleness of the ionosphere and the irritating habits of the cosmos are treated by A. G. McNish in "Ionospheric Research" and by J. W. Herbstreit in "Cosmic Radio Noise"; both men work in the Bureau of Standards, and their reports cover almost exclusively the post-1939 research. McNish points out that much more data are required on a world-wide basis, and a comprehensive theory of the ionosphere which will explain the complex features discovered during the War is needed. Cosmic noise has been shown to be so important that the lowest usable field intensity for radio communication is set by it. Its origin is still obscure, and the study of cosmic noise is another approach to the understanding of the heavens.

"Propagation in the FM Broadcast Band" is reviewed by K. A. Norton. It may come as a shock to readers that, within a year, the frequency-modulation broadcast stations in the United States will probably exceed the pre-war number of conventional amplitude-modulation stations, and a review of the factors which influence frequency-modulation propagation is most timely. Frequency-modulation avoids to a large extent the interferences reviewed in the two previous articles; but Norton emphasizes that we are still only beginning to learn about propagation characteristics in the frequency-modulation band—now set at ~ 100 Mc. in the United States. The article will be eagerly read in Great Britain by advocates and opponents of the system.

The last article is by J. A. Pierce, on "Electronic Aids to Navigation", and includes all the war-time developments in this subject; but the article does not carry a single reference, so that the research worker will not be in a much better position for further study.

The book is very well presented and appears to have few blemishes. If future annual volumes are as good, the "Advances in Electronics" will have an important place on our bookshelf.

T. E. ALLIBONE

THE BADGER AT HOME

The Badger

By Ernest Neal. (New Naturalist Monograph Series.) Pp. xv + 158 + 25 plates. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1948.) 12*s.* 6*d.* net.

THIS monograph on the badger by Ernest Neal is, I think, the best book that has been published on this nocturnal animal. The author has a literally astonishing knowledge of the badger and its habits, and he is able to set down this knowledge in an attractive form and in good and readable prose. The reader with him visits the badger's setts, and there watches the fascinating chapters in the animal's life. He sees a badger emerge from the sett or earth, scratch himself, romp with his mate, and call out the young ones.

Knowing the animal as he does, Mr. Neal is in a strong position when he puts in a plea for the badger. He cannot understand why it excites so great animosity, and says that it is a beneficial animal and should be protected, not destroyed. He says that foxes habitually live in badger setts, and believes the fox is responsible for almost all the lambs presumed killed by badgers and found near their setts. Does it kill poultry? Yes, but rarely. Its food is young rabbits (it has an uncanny faculty of finding these in the nest), rats and mice, snails, slugs and the like, and it does good by destroying many wasps' nests for the grubs, of which it is passionately fond.

The author is doubtful if the badger hibernates in Great Britain; they were, he says, active in thirty-four degrees of frost on February 25, 1947. He mentions that, whereas the gestation period has been put at twelve months, he considers it to be only seven months, and gives careful reasoning to support his views. When he watches at a sett, the author does his best to have a tree as a background, for he has found that a badger's sight is poor, and that it relies on its keen scent rather than on its sight to warn it of danger.

The book is illustrated by some beautiful and remarkable photographs; that forming the frontispiece, of a badger at night, is, I imagine, the first colour photograph ever taken of this animal. The author gives a map showing the places where the badger is most numerous, where it is scarce, and where it is not found. Is he right to give the Isle of Skye as one of the places where it is unknown? I seem to remember that it haunts or haunted a small wood at Kingsburgh in that island.

SETON GORDON

Annual Review of Microbiology

Charles E. Clifton, Editor; Sidney Raffel, Associate Editor; H. Albert Barker, Associate Editor. Vol. 2. Pp. viii+532. (Stanford, Calif.: Annual Reviews, Inc.; London: H. K. Lewis and Co., Ltd., 1948.) 6 dollars.

IN this, the second volume of a new series of annual reviews, an attempt is made to survey major aspects of the vigorous and ever-widening field of microbiology. Broadly speaking, the matter presented ranges over the physiology, pathogenicity and genetics of fungi, bacteria, protozoa and viruses; but particular themes such as antibiotics, the nature of antibodies, the inheritance of immunity, the mode of action of therapeutic agents, nitrogen fixation, chemical disinfectants and the microbiology of soils, drinking water and sewage, have also received attention. In a work which is intended to provide up-to-date information over a wide field, it would be invidious to pick out particular essays for special mention; indeed, as some of them run to forty or fifty odd pages, it would be difficult to do justice to any one of them in a short review. The reader is, however, assured of a wealth and diversity of information both in the text and in the comprehensive bibliographies.

Differences of opinion doubtless exist as to the content and function of annual reviews. Those of the kind under consideration tend to be of the nature of compilations—in the preface the editors refer to "the task of compiling critical and, at the same time, comprehensive reviews". While the several papers included in the annual volume afford an adequate account of what is going on in particular fields, there can be little doubt that they will gain in value in so far as the attempt is made not only to carry out a paper-to-paper survey, but also to pick out and emphasize the major contemporary lines of advance and to summarize briefly the main conclusions which have been reached or to which the new discoveries point.

The Failure of Metals by Fatigue

Proceedings of a Symposium held in the University of Melbourne, December 2nd–6th, 1946, under the ægis of the Faculty of Engineering. Pp. xvi + 505. (Melbourne: Melbourne University Press, 1947.) 42*s*. net.

THE holding of symposia to discuss present views on a particular subject is becoming increasingly popular. Each provides the occasion for pooling available scientific knowledge in a particular field, to the great convenience of individual workers on the subject. The main benefit, however, as Dr. H. J. Gough says in his foreword to this volume, is in the provision "of a spring-board from which valuable researches will be launched".

Thirty papers read at a symposium in Melbourne in December 1946 are here collected. Two-thirds of the papers are by Australians, but the names of A. G. Pugsley, U. R. Evans and H. O'Neil are among those from Great Britain, with H. F. Moore and G. Sachs among the contributors from the United States. While the papers are generally of high quality, there is no important new contribution to our basic understanding of the phenomenon of fatigue. The papers give practical examples of the occurrence of fatigue failure in specific service conditions, analyse the conditions promoting reversed stresses of sufficient intensity and suggest methods by which failures could be avoided. Important summaries of our knowledge of the mechanism of fatigue failure are included, and there are papers on testing techniques which, although in some cases on the fringe of the field of fatigue failure, are nevertheless of considerable importance in its understanding or its investigation.

All papers are not of the same high level (for example, the writers on fatigue failures of lead cable sheathing seem inadequately informed on previous British work in this field), but the book is one which justifies the considerable trouble that the promoters of such a symposium must have taken. The absence of an index is deplored. G. L. BAILEY

Inorganic Process Industries

By Prof. Kenneth A. Kobe. Pp. vii+371. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1948.) 30*s*. net.

THIS book is intended to impress on students the importance of following the evolution of an industry and of keeping abreast with modern developments by studying the literature. The first chapter gives a very comprehensive method of studying the literature. The remaining nine might better be entitled "Some Inorganic Industries in the United States", and consist of a series of descriptive articles, each of about 40 pages, on the main heavy-chemical industries. These are presented in a historical manner, contain no references, and do not emphasize new developments. At the end of each chapter a number of articles is listed as a recommendation for students to read. These are almost exclusively of American origin. Except for a few historical references, the subject-matter is confined to the manufacture of sodium and potassium salts, chlorine, sulphuric acid, and nitrogen and phosphorus compounds in the United States; and the book can scarcely be expected to appeal to British readers, in spite of an admirable set-up, clear diagrams and good printing. H. E. WATSON

The Works of George Berkeley, Bishop of Cloyne

Edited by Prof. A. A. Luce and Prof. T. E. Jessop. (Bibliotheca Britannica Philosophica.) Vol. 1: Philosophical Commentaries, Essay towards a New Theory of Vision, Theory of Vision Vindicated. Edited by Prof. A. A. Luce. Pp. viii + 280. (London and Edinburgh: Thomas Nelson and Sons, Ltd., 1948.) 30*s*. net.

THIS first volume of the new complete edition of the works of Berkeley is most welcome and is a handsome well-produced book worthy of its subject. Fraser's editions of 1871 and 1901 have been useful, but have some serious defects. Fraser discovered the notebooks containing Berkeley's "Philosophical Commentaries", but failed to see that they had been bound together in the wrong order. His transcription was not always accurate. Prof. Luce's magnificent edition of 1944 put right these defects and provided invaluable notes. He here reprints the "Commentaries" in handier form with shorter notes, sufficient for explanatory purposes. The "New Theory of Vision" never presented serious textual difficulties; but Fraser did not distinguish properly the alterations made by Berkeley in his life-time and does not appear to have used the last version. Prof. Luce reprints this fourth and last edition, indicating all alterations. In his introduction, while stressing the permanent value of this work of Berkeley, he mentions a point often forgotten, namely, how much it owed to the influence of Molyneux.

The "Theory of Vision Vindicated" is here for the first time available in a really intelligible form; Fraser unfortunately used a very imperfect version that had been printed by Cowell. This short work of Berkeley is valuable because it effectively corrects the false impression sometimes produced on modern readers of the "New Theory of Vision". That was the first thing Berkeley published; it embodied a strictly technical discussion of the processes of sense perception; it was a necessary preliminary to his philosophy, but did not require its explicit statement. Had he introduced the novel conceptions and the terminology of his "Principles", to be published in the following year, his first readers would have been confused. Berkeley's care for the difficulties of his contemporaries created difficulties for later readers. These, knowing the views of the "Principles" and finding apparently contrary views in the "New Theory", have often accused Berkeley of inconsistency. Anyone who takes the three works in this volume together will see that there is no inconsistency. A. D. R.

Weather Forecasting

By Instructor-Comdr. S. W. C. Pack. Pp. 192+8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1948.) 25*s*. net.

INSTRUCTOR-COMMANDER S. W. C. PACK is concerned more with the fundamental bases of synoptic meteorology than with the actual details of weather forecasting. As a grounding, his book is comprehensive, beginning with the structure of the atmosphere and, briefly, meteorological instruments, and continuing with a good deal of climatology, which is an essential background to all weather forecasting. Incidentally, the thermometer at Blackadder which recorded a minimum of −23° F. was *not* conventionally exposed. The chapter on "Fronts" and the development of depressions is on the usual lines; but wind in relation to pressure gradient is more clearly demonstrated than is usual in text-books. The most detailed and best part of the book is the treatment of adiabatic changes, dry and saturated, and the discussion of the tephigram and its uses in determining stability or instability; this should make a difficult subject clear to most students, as should also the later chapter on the variation of wind with height. The chapter on analysis and forecasting covers only eleven pages and is disappointing; there is no actual example of the analysis of a chart, either at ground-level or in the upper air. The book is well illustrated with photographs and clear diagrams, but seems high-priced for its size.

A Statistical Analysis of Advertising Expenditure and of the Revenue of the Press

By Nicholas Kaldor and Rodney Silverman. (National Institute of Economic and Social Research, Economic and Social Studies, 8.) Pp. xiv + 200. Cambridge: At the University Press, 1948.) 15*s*. net.

THIS book arose from a proposal made to the National Institute by the Advertising Association that an impartial inquiry should be made into the economic effects of advertising. The authors have carried out a very difficult task with extreme competence and are to be complimented particularly on their method of presentation. The main emphasis has been placed on the period 1934–38, with the result that we now have a comprehensive statistical survey of advertising expenditure in the United Kingdom for the pre-war years. Figures relating to the revenue of the Press extend to more recent years—up to 1944.

This is a most interesting example of what can be achieved when a research body has the full co-operation of professional and trade associations, together with the support of individual firms. Analyses of this nature will be of particular interest to the historian of economics, and it is to be hoped that they will be repeated at regular intervals in the future. The main findings are clearly summarized in the first part of the volume in order to save the time of the less statistically minded reader, and the authors have wisely refrained from detailed comment, leaving the facts to speak for themselves. The second part is devoted to a detailed description of the methods by which the various estimates have been made. Consequently, the book can be strongly recommended to students of economics, not only for its subject-matter but also for the insight which it gives into methods of approach.

In passing, it is interesting to note how handicapped the investigators were in the absence of a census of distribution. One small criticism is that many references are made to sources of information. While most of these are to be found among the index, it would be helpful to the specialist reader if in a subsequent edition they were to be listed in a bibliography. E. C. DANIELS

Le Bartonien du bassin de Paris

Par L. et J. Morellet. Pp. viii + 437. (Paris: Service de la Carte géologique, 1948.) N.p.

LUCIEN MORELLET, whose death occurred in 1945, was one of the many distinguished French geologists who have devoted their attention to the richly fossiliferous Eocene deposits of the Paris Basin. In collaboration with his brother, Jean Morellet, he studied especially the calcareous algæ, on which he was recognized as a world-wide authority, and the Parisian Eocene strata above the Lutetian. The results of more than forty years of observations and collecting by the two workers on this latter subject have now been edited and arranged by M. J. Morellet, and issued as a memoir of the Service de la Carte Géologique.

This study lists and describes in detail, with copious fossil lists, almost all sections in the Paris Basin 'Etage Bartonien', many of which have been long since obscured, discusses the significance of the fauna and flora with regard to palæogeography and climate, and reviews the history of the classification and correlation of strata at this horizon. In coming to a decision on this vexed question, the authors are wisely tolerant, recognizing the difficulties inherent in the study of these variable strata, and admitting frankly that it is unfortunate that 'Bartonien' was initially proposed for Parisian strata and not for the familiar Barton Beds in England. If it is too much to expect that all students of the Eocene will agree with their 'Bartonien' covering all Eocene beds above the Lutetian in France, and ranging in England from the base of the Upper Brackleshams to the top of the Lower Headons, the supporting evidence and common-sense nature of the final decision for a single stage are obvious, even if the name retained is unwise.

Meanwhile, the volume is a magnificent detailed record of a type-area invaluable to all students of the older Tertiary, and a fine memorial to the life-work of L. Morellet and the long collaboration between the two brothers; M. J. Morellet is to be congratulated. G. F. E.

STRUCTURE AND ACTIVITIES OF THE BACTERIAL SURFACE

ON April 20 the Society for General Microbiology held a symposium on "The Nature of the Bacterial Surface". Seven contributions and two surveys by the chairmen had been printed and circulated to members of the Society before the meeting. On the assumption, which proved to be well founded, that these had already been read by those attending the symposium, most of the time of the meeting was spent on discussion. Argument had to be restrained rather than promoted by the chairmen, and it ranged over a wide but relevant field; although the meeting was extended beyond the time arranged, it finished with several members still wishing to speak.

There was general agreement on many subjects. Several speakers pointed out that the microscopically visible capsule is dispensible and that there are no definite divisions between the successive layers by which the cell is surrounded; these views were not controverted. Opinion varied over the extent to which electron-micrograms give direct evidence about the original material that is being examined; but, after some years of rather uncritical acceptance of electron-micrograms at their face value, it was refreshing to find that there was general awareness that changes can take place during the preparation, drying and shadowing of a specimen. Finally, the suggestion that the macroscopic properties of films, fibrils and threads are not an infallible guide to the properties of similar, but much smaller, structures, may be mentioned. No one postulated new properties of matter; but there was agreement that we should beware of arguments based on the extrapolation of the conventional properties of matter to bacterial appendages that may be only one-thousandth the size of structures that have already been thoroughly investigated.

Evidence coming from the serological properties of bacteria, and of antigens prepared from them, was considered by W. T. J. Morgan. He argued that the failure of a serological reaction does not necessarily mean that the structure which should have reacted is placed deeply in the organism; it could be near the surface but in a state of chemical combination that keeps it from reacting, or it could be surrounded by larger amounts of a more reactive antigen. In discussion, C. M. Chu stressed the importance of a serological study of the bacterial residue left after the mild extraction procedures advocated by Morgan. In this way more light might be thrown on the actual location of antigens which appear to lie on the surface.

A comprehensive picture of the chemical processes involved in Gram-staining, in the synthesis of capsular polysaccharides, and in the action of the pneumococcal transforming principle, was presented by M. Stacey. Harriett Taylor criticized this picture with logic and pertinacity. Stacey suggested that the deoxyribose nucleic acid, the presence of which promotes capsule formation by non-capsulated pneumococci, is contaminated by traces of capsular polysaccharide, and that this, by analogy with other cases where polysaccharide is needed as a starter for polysaccharide synthesis, is the effective substance. She agreed that the deoxyribose nucleic acid, like all large molecules, is probably contaminated, but looked on the capsular polysaccharide as one of the less probable contaminants. Stacey's suggestion that the Rough pneumococci have less nucleic acid on their surfaces than the Smooth, and that roughness results from growth under deficient nutritional conditions, she likewise emphatically rejected. There were repercussions of this disagreement in the discussion after Harriett Taylor's paper on pneumococcal transformation. It seems to originate in the orthodox chemist's unwillingness to accept the enormous number of specific nucleic acids called for by some biological evidence. Until we know something of the minimum size of these postulated active nucleic acids, and of the effect which a change in nucleotide sequence has on specificity, this unwillingness seems premature. It is easy to get the required number of isomers if every difference in sequence is significant. In Taylor's paper, examples had been given of deoxyribose nucleic acids made from different strains of pneumococcus that are chemically indistinguishable but differ biologically.

Work with the pneumococci suggests that the bacterium can at one time have only one type of capsule and one type of transforming principle—as if there is a single locus which can be occupied by only one type of transforming substance. A somewhat different form of 'exclusion principle' was described by D. McClean. Streptococci can have either hyaluronic acid capsules or they can secrete hyaluronidase, but not both. The addition of hyaluronidase to capsulated organisms decapsulates them, whereas the addition of hyaluronic acid to some streptococcal cultures stimulates the adaptive formation of hyaluronidase. We have here a fascinating field for studying the interplay of the biochemical factors on which the morphological and other properties of an organism depend.

Peter Mitchell considered the properties of the osmotic barrier. He was more concerned with what the barrier does and how it does it than with what it is made of and how thick it is. He showed that for many substances it cannot be regarded as a passive filter, acting by virtue of differences in pore size or partition coefficient, and suggested mechanisms by which osmotic work could be done in the barrier. In discussion, the problem was skilfully defined by K. A. Bisset, who contended that there is no reason to postulate any thickness for the osmotically active layer. In his view it may well merge with the cytoplasm of the cell and so have no defined inner surface.

The reaction between bacterial viruses and the cell involves a series of changes in the bacterial surface; T. F. Anderson discussed the conclusions that can be drawn from this line of evidence. His own work and Schlesinger's shows that the observed number of effective collisions between bacterium and virus agrees with the number theoretically to be expected with particles of these sizes. This means that, in spite of the specificity of the action, nearly every collision is effective. He suggested that this could come about if the first connexion is with a plastic structure on which subsequent rearrangement can take place or which, if this fails, can break off from the organism. With his group of viruses, so long as host and virus have not been deliberately inactivated, absorption only takes place on to cells capable of sustaining virus multiplication. The surface carries "frank, specific displays of its range of suitability as

a host for the viruses to which it is sensitive". In the introduction, N. W. Pirie had stressed the lack of evidence that viruses penetrate the bacterial cell wall; their multiplication on, rather than within, the wall would be compatible with Anderson's evidence. As often happens when viruses are under consideration, the discussion took on a slightly metaphysical tinge. Felix urged a return to Bordet's view that bacterial viruses are fragments of the bacterial cell; but Anderson, because of the absence of serological relationships between the viruses and host cell constituents, saw no advantage in this hypothesis. A lysin can be made by ultra-violet irradiation of some viruses; A. Pirie asked if this should be looked on as an enzyme attacking a substrate in the cell surface or as an activator for the autolytic mechanism already present in the surface. Anderson said he did not know how often a molecule had to do the same job, without being destroyed, before it should be called an enzyme. There is no evidence that the substances postulated in these processes act more than once.

The part of the bacterium that is responsible for its mechanical integrity was only discussed briefly. I. M. Dawson showed electron-micrograms of the rigid cell wall made by centrifugal fractionation of a suspension of staphylococci that had been shaken with glass beads, and J. Smiles described the elastic properties of the membrane surrounding various organisms and of the septa which form before or during cell division. In different organisms these structures have characteristically different properties when subjected to stresses by flow of the medium or by drying. The general properties of these membranes were surveyed by E. T. C. Spooner from the point of view of the bacteriologist, but nothing was said about their chemical nature.

The last paper to be discussed was by A. Pijper, on bacterial motility, and this subject was also the main theme of A. A. Miles's introduction from the chair. Pijper contends that bacteria move by virtue of an undulatory or corkscrew movement of their bodies, and that the flagella are wisps of slime trailing in the medium. He does not deny the existence of flagella, but looks on them as the consequence rather than the cause of motility. Observations on living bacteria under dark-ground illumination with sunlight give the main evidence for this point of view, and some of the phenomena were illustrated by a cinematograph film. Here it appeared that the direction of movement of the body is the first thing to change, and that it is only after this has happened that the flagella move round to the rear of the moving organism. Pijper's view was hotly contested. T. Y. Kingma Boltjes thought the mechanics very improbable and preferred the conventional interpretation of motility. A. Fleming confessed himself nearly convinced, but found his own observations on the rotational movements of *Proteus* grown in the presence of penicillin more nearly compatible with the concept of active flagella. This movement only takes place when the specimen is illuminated, and it appears that, when the light is turned on, flagellar movement precedes movement of the organism. The uniformity of flagella in electron-micrograms, and especially the fact that in one organism (unclassified) two distinct sizes are seen, together with the constancy with which the same number of flagella are seen in the same place on the members of one species, seemed to A. L. Houwink to rule out the trailing slime hypothesis. A similar attitude was taken by W. van Iterson, who showed electron-micrograms of flagella apparently connected with the protoplast or with granules. Their formation from these structures would suggest that they are not formed by the casual streaming away of surface slime but are a specific extrusion. What is known of the chemistry of flagella makes such an origin probable. Conclusions about their origin do not, however, radically affect the problem of flagellar movement and, although Pijper's interpretation contains undoubted difficulties, no clear refutation of it was forthcoming.

It was generally agreed that this symposium was valuable, and that much of its value depended on the 'preprinting' of the main contributions. This technique is already used regularly by some societies; but its expense is bound to keep it from being adopted widely. It may therefore be legitimate to argue briefly the national economics of such meetings. Three hundred people attended this one, and at least two hundred of them were paid directly or indirectly out of public funds. The average of their salaries is certainly not less than £2 per working day. For an all-day meeting some are away for more than a day and many get travelling expenses. The hidden cost to the community of such a meeting is £500 at the lowest estimate, quite apart from the ordinary cost to the society. This expense is fully justified; but it is important to recognize that it is there, and to ensure that the best use is made of the time and money spent. If, by 'preprinting' the papers, we can increase significantly the value to the participants of the time spent in a meeting, it seems not unreasonable that the cost of 'preprinting', £100–£200, should be borne by public funds.

N. W. Pirie

NATURAL PRODUCTS IN THE BRITISH COLONIAL EMPIRE

THE second report of the Colonial Primary Products Committee*, dated January 1949, consists mainly of a series of commodity studies, to which is appended a note by the Imperial Institute on distillation of essential oils, describing inexpensive plant for this purpose. Recommendations of the Committee in regard to groundnuts are discussed elsewhere (p. 889 of this issue); in regard to oil-palm products, the Committee recommends the introduction of a superior grade to encourage the production and sale for export of an oil suitable both for edible and technical purposes. The Committee considers that for coconut products a long-term assurance is of the first importance; but of other edible oils and oil-seeds yielding edible oils produced in the Colonial Empire, kapok seed, neem oil and dika fat are unlikely to be of use for edible purposes, special encouragement of sesame is not recommended, and of the minor oil-seeds only cottonseed and illipe nuts appear worth encouraging. The best hope of increased production of soya beans in the near future appears to lie in East and Central Africa, and the Committee hopes that the assured market will stimulate increased production there, and that departments of agriculture will pursue their variety trials. It suggests that if the large-scale trials of sunflowers as a rotation crop in Tanganyika prove satisfactory, consideration should

* Colonial Office. Colonial Primary Products Committee. Second Report, January 1949. (Colonial No. 238.) Pp. (0. (London: H.M. Stationery Office, 1949.) 1s. net.

be given to growing the crop extensively elsewhere. It also considers that every effort should be made to increase Colonial production of drying oils to reduce the gap between sterling demand and sterling supply, and hopes that the present acreage of linseed in Kenya will be maintained, if not extended. Attention is also directed to the considerable possibilities of the candlenut tree, *Aleurites moluccana*, as a native-grown permanent tree crop, and to the desirability of establishing trial plantings over a wide range of conditions. It is suggested that the Colonial Products Research Council should undertake decortication trials with samples of nuts with the view of evolving a suitable decorticator for Colonial conditions. Production in the Empire of tung oil is centred in Nyasaland, and if the yield from the Colonial Development Corporation's project in the Vipya Highlands materializes, together with production in the Southern Province in eight or ten years, much of the United Kingdom's demand should be met. Trials with the cultivation of high-yielding strains of castor giving non-scattering seeds are recommended, and also further trials of rubberseed oil and the cultivation of *Tetracarpidium Conophorum*. Encouragement of the cultivation of perilla, niger seed, chia oil, ongokea or isano oil, poy-ok oil and tee-seed oil is not recommended for reasons given.

The three main kinds of starch produced in the Colonies are arrowroot, sago flour and tapioca starch. There is every reason to increase the growing of arrowroot, and it is hoped that two grinding mills of an improved type will permit an increased yield to be obtained in St. Vincent from the root. Growing in Grenada is also proposed; but no unqualified recommendation is given for increased production of cassava for starch.

The Committee considered in detail the production and marketing prospects of a considerable number of essential oils; it recommends, however, stimulation or exploration of production only for cajuput, cananga and ylang ylang, eucalyptus, geranium, juniper, lavender, neroli, patchouli, peppermint, petitgrain, spearmint, thyme, vetiver or 'cus-cus' and wormseed. Of the citrus oils, the production of a better quality of grapefruit oil should be encouraged. New production of citronella oil would have to compete in well-established markets, and future production of cloves and clove-stem oil in Zanzibar and Pemba is likely to be affected by a serious outbreak of the 'sudden death' disease.

With regard to timber, the Committee considers that while it will be a long time before softwood production can be developed on a large scale, the hardwood exports of British Colonial territories are capable of very substantial expansion; but maximum production cannot be secured without a great improvement in the supply of machinery, in communications and increased staff. There is much scope for research in sylviculture and conservation, and especially on utilization. Maximum production depends on such matters as the increased conversion of timber from the log, particularly of secondary timbers, to economize on the freight of logs by transporting them in semi-processed form, and the development of veneer and plywood manufacture in the Colonies.

In regard to paper pulp, there are many products from which paper pulp of varying qualities can be made, but the number of economic materials is reduced by considerations of homogeneity, accessibility and certainty of supply. While there are a number of lines of inquiry, particularly into eucalyptus and wattle, which can be profitably pursued, the Committee believes there is at the moment no project which can be confidently recommended as a practical proposition. Reviewing the position of tanning materials, the Committee considers that owing to the war-time consumption of quebracho for fuel and the serious spread of disease among the chestnuts of South America, there is risk of a world shortage of vegetable tanning materials in the next twenty years if alternative sources of supply are not developed. Wattle is the most promising source of such materials in Colonial territories, and its cultivation should be encouraged, particularly on the highlands of East and Central Africa. The Committee also estimates that present schemes of development could increase Colonial production of tobacco by about fifty per cent, if the equipment, skilled labour, finance and fertilizers are forthcoming. While, however, the Colonies will continue to supply an appreciable part of the United Kingdom's requirements of pipe tobacco, they contribute to a very limited extent only to those of cigarette tobacco.

The Committee has also considered Dr. C. F. Hickling's report on "The Production of Fish in the Colonial Empire", since issued as Colonial No. 237*; it regards this report of the Fisheries Adviser to the Secretary of State for the Colonies as expressing adequately its own views. Dr. Hickling outlines the training now being given to some twenty-one fishery officers, and emphasizes the importance of studying methods of fish preservation with a view to their improvement by research. A fish preservation research officer is to be attached to headquarters, who will advise Colonial Governments as well as conduct research. A large sample of salted fish and of shark has been sent to the managers of the East African groundnut scheme for evaluation; and biological research on the fish taken in the survey of the Mauritius and Seychelles area of the Indian Ocean is also being carried out, and a biochemist has joined the survey. A West African Fisheries Research Institute is being established at Kessy Dockyard in Sierra Leone, and the scheme provides for long-term research on the productivity of the sea off West Africa. In Uganda, research is provided by the Fisheries Research Station at Jinja, and plans are being drawn up for a fisheries research station in Northern Rhodesia. Research in the South-East Asia region is to be provided for by a large research station, preferably at Singapore, which with its research vessel should cover the area from the Andaman Islands to North Borneo. A scheme has been approved for a centre for research and training in fish culture in Penang, Malaya.

Generally, it is considered that while there is considerable scope for increasing the Colonial production of fish, such increased production will be absorbed by the Colonies themselves, and except from the Gulf of Aden, Hong Kong and the Mauritius–Seychelles areas, surplus for export is unlikely. Increased production depends largely on the application of mechanized methods, which is hindered by difficulties in obtaining ships, equipment and trained staff. Although these deficiencies are being overcome, Colonial Governments must be prepared to make the necessary expenditure. Reference is also made to the development of by-products such as shark-liver oils, isinglass, and alginic acid and agar-agar from seaweeds.

* Colonial Office. Production of Fish in the Colonial Empire. (Colonial No. 237.) Pp. 14. (London: H.M. Stationery Office, 1949.) 4d. net.

CHINESE CERAMIC GLAZES

WITH SPECIAL REFERENCE TO THOSE DERIVED FROM COPPER*

By A. L. HETHERINGTON, C.B.E.
Honorary Secretary of the Oriental Ceramic Society

THE Chinese potters employed for the colouring of their glazes prior to the fourteenth century two metals, and two only, for the great majority of their effects. Those two metals were iron and copper, and both continued to be used extensively in subsequent times. But other metals then came into wider use as well, notably cobalt for the well-known blue and white wares, and, later still, gold for the familiar group known as *famille rose*.

The Chinese potter first used copper on an extensive scale for colouring his glazes in the T'ang dynasty, A.D. 618–906. In that dynasty the potter produced a variety of green glazes from cupric oxide which are relatively easy to produce. In the subsequent periods, green glazes were made in profusion and in a variety of shades. While there is not much evidence of copper greens in the succeeding Sung dynasty—960–1279, or, say, from the date of the crowning of Otto I as Holy Roman Emperor to that of the signing of Magna Carta—they were made in great variety in the Ming and Manchu dynasties; that is, during 1368–1912, or from the date of Chaucer to modern times.

Cupric oxide in a glaze gives rise to a range of colour from blue to green, and these colours are accounted for by the varying amounts of cupric oxide present and especially by the nature of the glazes in which it is incorporated. The more basic the glaze, the greater will be the tendency to a blue colour; and the more acid the glaze, the greater will be the predominance of the green.

Cupric oxide dissolves in a glaze formed of potassium silicate or of sodium silicate, or a mixture of the two, to give a blue colour at about 1,300° C. If alumina is present as well, there is a considerable tendency for the blue to turn to green. If lead is present, the potash lead silicate glaze is blue, but tends to green if the lead is in excess. To retain a blue colour, the alkaline constituent must be relatively high, and if alkali is lost by volatilization, the glaze becomes acidic and green will result. But the alkali content must not be too high, since then the glaze becomes unstable and is liable to break down on exposure to a humid atmosphere.

The blue glazes from cupric oxide were not mastered until the Ming and Manchu dynasties. It was, and is, a difficult colour effect to produce. The greens from copper are relatively simple in comparison.

The fact that ceramic production in China from the Ming dynasty onwards was mainly centred in the ceramic metropolis of Ching-tê-chên, where an enormous number of operatives were employed under imperial patronage, no doubt accounts for the greater technical skill responsible for this and other glaze effects.

Under reducing conditions, copper in a glaze produces the range of reds which are familiar; the famous *sang de bœuf* and the peach-bloom glazes, as well as a variety of other shades of red, are due to copper. These copper-red glazes are brought about by the reduction of cupric oxide to the metal itself in a finely divided colloidal condition. In order to produce a clear blood-red glaze, not more than one half of one per cent of copper must be present. If more than that is put into the glaze, the colour becomes opaque, with a red sealing-wax appearance.

The chemistry of the copper-red glazes was established by Dr. J. W. Mellor and may be briefly summarized as follows. The red colour is due to the even aggregation of finely divided colloidal particles of copper to form a band in a certain portion of the glaze. The formation and maintenance of this red band are assisted by the presence of iron (or tin) oxide. The effect is brought about by a reducing atmosphere at the outset, and the glaze is finished off in an oxidizing atmosphere.

Colloidal copper, when in a very fine state of division, is yellow; in a slightly less fine state it is red, and when the particles are slightly larger still, they look blue by transmitted light.

At the outset, under strong reducing conditions, the cupric oxide is reduced, and any iron present is reduced to ferrous oxide. The atmospheric oxygen, on its introduction, attacks the molten glaze and oxidizes the topmost layer, converting the copper to cupric oxide. As a result, the surface layer of a copper-red glaze is colourless, or faintly green from the small amount of copper in the glaze. Below that layer the oxidizing action is relatively slight, and a layer of yellow can generally be seen consisting of finely divided particles of colloidal copper. Below that layer there is no oxidizing action on the part of the atmospheric oxygen, and a red band of slightly larger sized colloidal particles appears, below which is a narrower band of blue particles of slightly larger size still. The iron oxide present helps to stabilize the colloidal copper and keep it dispersed to form and maintain the red band.

The famous peach-bloom glaze is a variety of the *sang de bœuf* in which the attack of the atmospheric oxygen is allowed to continue longer. As a result, the red colour is diminished to a pinkish-red with the blue particles showing faintly below it. Sometimes in these peach-bloom glazes, which are difficult to produce in perfection, green spots appear. These green spots are due to colloidal particles of copper forming small aggregations by flocculation. These are oxidized to cupric oxide by the atmospheric oxygen and immediately dissolve in the glaze to give the characteristic green of cupric oxide.

An on-glaze copper-red glaze which is entirely different from the in-glaze effect can be produced by the formation of a copper aerosol as a thin layer of copper particles near the surface of the glaze.

* Summary of a Wednesday Evening Discourse at the Royal Institution, delivered on May 18.

OBITUARIES

Mr. F. N. Ashcroft

IT was with deep regret that his many friends heard of the sudden death in London on April 4 of Frederick Noel Ashcroft. He had just completed a great task as honorary treasurer to the Eighteenth Session of the International Geological Congress. His careful attention to detail and his devotion to the work contributed largely to the great success of the Congress. He was publicly thanked for his work at a meeting of the Geological Society on March 23. Ashcroft brought to this task a wide knowledge of business accounts. He had been honorary treasurer of the Geological Society of London during 1929–47,

and of the Mineralogical Society during 1920–42; also he was a managing trustee of the Geologists Association and of the Mineralogical Society. He was also honorary treasurer and vice-chairman of the Metropolitan District Nursing Association, with which he had been connected as a member of the Executive Committee since 1920. He was president of the Mineralogical Society during 1942–45, and at the time of his death he was its foreign secretary; he was also a vice-president of the Geological Society.

To his many friends in London, it must have seemed that Ashcroft's whole life was devoted to the financial affairs of these societies; but he was first and foremost a mineralogist, and his lasting memorial in the years to come will be the two superb collections of minerals which he had presented, or has now bequeathed, to the British Museum (Natural History), documented with an accuracy which few others would have had the patience and knowledge to achieve.

Ashcroft went from Rugby to Magdalen College, Oxford, in 1897, and gained a first in honours chemistry in 1901. He worked at Tübingen in 1901 and later at University College, London, in the Department of Organic Chemistry, and published a paper in the *Journal of the Chemical Society* in 1907. At Oxford he had also studied mineralogy under Miers, from whom, like so many others, he acquired an interest in minerals which decided the main lines of his future work. Ill-health prevented him from undertaking any full-time work; but Ashcroft could not be idle and he devoted himself to the study and collection of minerals, working partly in the Mineral Department of the British Museum and partly in the Chemistry Department of University College, London, where J. Norman Collie, himself a fair mineralogist, was professor. At first specializing in zeolites, Ashcroft brought together in the course of ten years or so a notable collection of these minerals from all over the world. In 1914 he presented the bulk of this collection to the British Museum, retaining only his Irish specimens, intending to continue publishing accounts of these when time allowed. It was well after the conclusion of peace, in 1920, that Ashcroft turned his attention to the minerals of the Swiss Alps. Here he set out not merely to acquire fine specimens, but also to record the exact localities where each was found and to collect representative specimens of all the minerals associated in each locality, thus bringing together all the data for a complete study of the distribution and paragenesis of the minerals. Carrying a heavy camera, hammers and chisels, he went round the recently worked localities with the mineral collectors on his annual visit to Switzerland, collecting, noting and photographing. He was an expert photographer and his catalogue is profusely illustrated by photographs of his own taking. Many of these were used to illustrate "Die Mineralien der Schweizeralpen" by Niggli, Koenigsberger and Parker, with whom Ashcroft collaborated. Others appear as plates in Arthur Holmes's "Principles of Physical Geology".

It was an education to accompany Ashcroft on one of these visits to the Alps and to see him at work. He had gained the affection of mineralogists and mineral collectors all over Switzerland, and if they were sorry to see their best specimens being taken to London year after year, they forgave him for the big kind-hearted enthusiast that he was. His collecting trips were usually followed by a holiday with his family. He had married in 1904 Constance Muriel, daughter of J. C. Im Thurn, and had two sons and two daughters. He was devoted to his family and very proud of his grandsons, and they were all devoted to him.

He had many friends among mineralogists at home and abroad. He was a member of the Swiss Mineralogical Society and of the Museums Association as well as of the other societies mentioned, and he was a charter member of the Mineralogical Society of America.

W. CAMPBELL SMITH

Mr. Edward Heawood

MR. EDWARD HEAWOOD, emeritus librarian of the Royal Geographical Society, died on April 30, in his eighty-fifth year.

Heawood was attracted to geography through an early interest in natural history, and the great narratives of exploration. After taking his degree in classics at Cambridge, he received instruction in surveying and other field studies at the Royal Geographical Society, and spent two years in India working on a settlement scheme among the Santals in the Bengal Duars. On his return, he joined the staff of the Society, assisting with the newly established *Geographical Journal* and in the library. On the retirement of Dr. H. R. Mill in 1901, he succeeded him as librarian, an appointment which he held until 1934. During these years the Society's Library expanded considerably under his guidance, particularly in its collections of foreign geographical periodicals and of early geographical texts and atlases. His extensive knowledge of the literature of geography, aided by an exceptional memory, was readily placed at the disposal of students.

His special interest was at first in African geography and in the history of exploration generally. His "History of Geographical Discovery in the 17th and 18th Centuries", published in 1912, is a careful and comprehensive study which remains the best general guide to that period. This line of study led naturally to that of the cartographic sources, to which his attention was increasingly given, until he had established a widely recognized reputation as an authority. Most of his work is to be found in the *Geographical Journal*, in numerous notes and reviews as well as in longer papers, but two important memoirs appeared as separate publications of the Royal Geographical Society: "The Map of the World on Mercator's Projection by Jodocus Hondius, 1608" (1927) and "English County Maps in the Collection of the R.G.S." (1932). A further development of this work, which was perhaps his most individual contribution, was his extensive study of water-marks used by paper-makers, which threw much light on the sources and distribution of paper, in addition to its use in dating maps and other documents. He concentrated upon marks on paper used in England, filling in the gap left by Briquet and other Continental writers. His first article, in the *Geographical Journal* of May 1924, was followed by others in *The Library* of 1930, 1931 and 1948. On the day of his death he had been at work on an index to a selection of his tracings of marks, which is to be published in Holland.

Heawood received the Research Medal of the Royal Scottish Geographical Society in 1933, and in the following year the Victoria Medal of the Royal Geographical Society. For many years he was treasurer of the Hakluyt Society, and had been recorder of Section E (Geography) of the British Association.

G. R. CRONE

Prof. J. Velenovský

THE death occurred on May 7 of the Czechoslovak botanist, Prof. Josef Velenovský, at Mnichovice, near Prague; he was ninety-one years of age.

Born at Čekanice, a small southern Bohemian village, on April 22, 1858, Velenovský was a student of Sachs and Čelakovský, and in 1885 he obtained a post at the Charles University of Prague. In 1898 he succeeded Čelakovský as professor and continued teaching for forty-two years until he retired in 1927. It was during his professorship that the present Botanical Institute was erected, and for many years Velenovský was also director of the botanical gardens attached to the Institute.

During his career he wrote at least four hundred different publications, including a number of text-books and treatises that served successive generations of Czech students. His early researches related to phytopalæontology, especially the fossil flowering plants occurring in Bohemian chalk (1882–87). His studies in this field were published in a work of five volumes, "Flora Cretacea Bohemiæ".

Later, Velenovský made a detailed systematic study of fungi, and he is probably best known in Great Britain for his "České Houby" (Bohemian Fungi), first published between 1922 and 1926 and revised in 1946. The book is noteworthy for its illustrations. He spent many vacations in the Balkans, and one outcome was his "Flora Bulgarica" (1891), the standard flora for the country and which he afterwards brought up to date with addenda. Later work was mainly concerned with studies of the bryophytes (1897), though he contributed to many branches of systematic botany, and as late as 1947 he was engaged upon "Novitates Mycologicæ Novissimæ", which is being published by the Czechoslovak Botanical Society.

After retiring, Velenovský maintained his scientific interests and also wrote some philosophical and historical essays. One of these was for the jubilee publication in 1932 of the Czech Naturalists' Club, of which he was the oldest living member. Velenovský received many Continental and some British honours. J. G. F. D.

NEWS and VIEWS

Plant Pathology Laboratory: Mr. W. C. Moore

MR. W. C. MOORE has been appointed to the post of director of the Plant Pathology Laboratory of the Ministry of Agriculture and Fisheries at Harpenden, on the retirement of Mr. C. T. Gimingham. Mr. Moore received his early education at Sexey's School, Bruton, whence he joined Trinity College, Cambridge, in 1919, becoming a major scholar in 1921. After graduation he remained at the Cambridge Botany School to participate in the investigations on silver-leaf disease of fruit trees then in progress. He joined the staff of the Plant Pathology Laboratory in 1925 as assistant in mycology, becoming mycologist in 1944 and deputy director in 1948. During his official career he has been in the closest touch with other British plant pathologists, especially those in the advisory services, whose work he has greatly fostered and assisted. Not infrequently he has suggested problems for investigation. Latterly, he has been responsible for editing a series of valuable reports on the incidence of plant diseases in England and Wales. He has taken a principal part in preparing the excellent leaflets on the diseases of economic plants issued by the Ministry. Notwithstanding heavy administrative duties he has continued his own researches (chiefly on little-known diseases), the results of which have been mostly published in the *Transactions of the British Mycological Society*. Noteworthy, too, is his bulletin on the "Diseases of Bulbs", published in 1939, which is an important contribution to plant pathological literature. He was president of the British Mycological Society in 1941 and of the Association of Applied Biologists in 1947–48. Mr. Moore is a keen gardener, and the practice of this art has been not without influence on his career as a plant pathologist.

Geology at Sheffield: Prof. Leslie R. Moore

DR. LESLIE R. MOORE, at present reader in stratigraphy in the University of Bristol, has been appointed to the Sorby chair of geology in the University of Sheffield, in succession to Prof. F. W. Shotton (see *Nature*, **155**, 664; 1945), who has been appointed to the chair of geology at Birmingham. It is expected that Prof. Moore will take up his duties at the opening of the new session in October next. After taking his first degree at the University of Bristol in 1934, Dr. Moore carried out postgraduate work on "The Sequence and Structure of the Somerset and Gloucestershire Coalfields", for which he was awarded the Ph.D. degree. His first university appointment was in the Department of Geology, University College, Cardiff; later he became research fellow and lecturer in geology in the University of Glasgow, before returning to Bristol as reader in stratigraphy. Dr. Moore's researches have dealt especially with the geology of coal measures and oil shales and are notable for the employment of new techniques, to the development of which he himself has made substantial contributions.

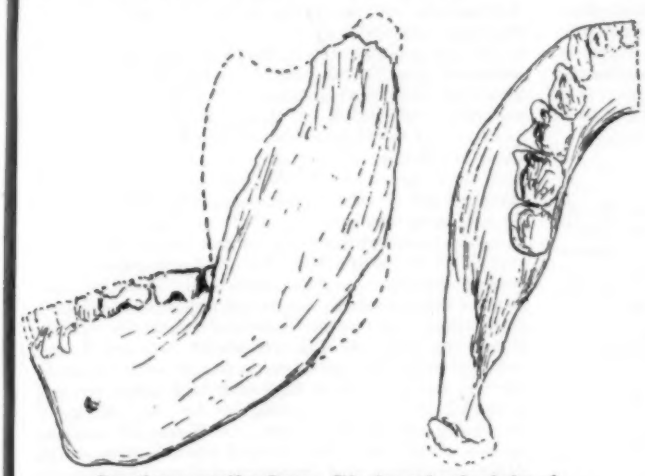
New Grassland Research Station at Hurley: Dr. W. Davies

DR. WILLIAM DAVIES, at present director of the Grassland Improvement Station of the Ministry of Agriculture and Fisheries at Drayton, Stratford-on-Avon, has been appointed director of the Grassland Research Station for Great Britain. This new station is being established at Hurley in Berkshire and is being amalgamated with the Drayton Station under the new Governing Body, the formation of which was recently announced. Dr. Davies was a student at the University College, Aberystwyth, under Sir George Stapledon, and was later a member of staff at the Welsh Plant Breeding Station at Aberystwyth. On the establishment of the Grassland Improvement Station, he was appointed assistant director, and became director in 1946 on the resignation of Sir George Stapledon. Dr. Davies has conducted researches and surveys in New Zealand, Australia and the Argentine. A survey of the grasslands of England was made in the years 1938–40, and the results were published in 1941. More recently, Dr. Davies has visited several African countries and carried out grassland surveys there.

Jaw of the Ape-Man *Paranthropus crassidens*

Dr. Robert Broom, of the Transvaal Museum, Pretoria, who is now on a visit to Great Britain, during which he has received the Wollaston Medal of the Geological Society of London awarded to him this year, writes as follows:

"In November 1948, we found at Swartkrans while excavating a new site in co-operation with the California University Expedition a lower jaw with very large molar teeth. I called it *Paranthropus crassidens*. Not only did we find the imperfect jaw of a young male with three upper teeth, but also some months later the snout of what appeared to be a female. The upper incisors and canine are typically human. Last month, while I was in America, my assistant, Mr. John T. Robinson, discovered an almost complete huge jaw with most of the teeth. I have, of course, not yet seen the specimen, but the accompanying drawings were made from photographs taken by Mr. Robinson. The jaw is really enormous—very considerably larger than that of Heidelberg man. The molar teeth are very large, but the canines and incisors remarkably small. Another remarkable feature about the jaw is that it has a rudiment of a chin. The ascending ramus is very high and large. Mr. Robinson has also got a part of the face with the nearly complete palate. This shows that the face is almost orthognathous. We must, I think, conclude that the brain was very large. It seems improbable that the brain can have been less than 800 c.c., and very likely it may have been more than 900 c.c. Mr. Robinson has just written me that he has part of a mandible with one molar tooth that looks remarkably human. While I can express no definite opinion until I see the specimen, it may be that the jaw is that of a small female of the same species as the large jaw."



Paranthropus crassidens Broom. Side-view and occlused view of left mandible. ½ natural size

British Gelatine and Glue Research Association

Mr. A. G. Ward has been appointed director of the newly formed British Gelatine and Glue Research Association. Mr. Ward's main interests have been in colloid science; in particular, the relation of colloidal structure to mechanical properties. During the War he was engaged on research on the mechanical and physical properties of propellants and plastics, together with studies on nitrocellulose, for the Ministry of Supply. This work included the use of X-ray diffraction technique to follow the changes in nitrocellulose structure in cordite manufacture. In 1946 he joined the Building Research Station of the Department of Scientific and Industrial Research to set up a Rheology Section for building materials, and he has since then published several papers on the rheology of pastes as well as two books on crystals and colloids.

Although the gelatine and glue industry is relatively small, its products are essential in many industries connected with food, photography, pharmacy and many household articles, and its by-products are fertilizers and fats. The industry has been founded on cheap raw materials such as hide waste and bones, and little change has taken place in traditional methods. Of late, production has expanded to meet all home needs and to capture export markets; but increased technical efficiency and new ideas are greatly needed if this activity is to be maintained. It was decided, therefore, in 1947 to form a Research Association. Preliminary work was done by the Federation of Gelatine and Glue Manufacturers, and already more than half the member firms have joined. The Research Association will work along the normal co-operative lines and will be assisted by a grant from the Department of Scientific and Industrial Research. Since the industry is not centred on any particular locality of Great Britain, the research laboratories will be set up in London. Work will be done in two main fields: fundamental research on raw materials and problems affecting the industry; and research with immediate practical application, including the possibility of new uses.

Italian National Awards: Einaudi Prizes

Through the generosity of Signor Luigi Einaudi, President of the Italian Republic, the Lincei Academy at Rome is to award four national prizes of a million lire each, at the end of every year of his term of office. The names of the first prize-winners have just been announced, as follows: General Prize (Mathematical and Natural Sciences): Prof. O. M. Olivo, of the University of Bologna, for researches in bio-electric phenomena of the cardiac cell; Prize for Physics: Prof. G. P. S. Occhialini, of the University of Brussels, for researches in nuclear physics and in particular for his work on the discovery of the heavy meson; General Prize (Moral Sciences): Prof. R. Mondolfo, of Bologna, for work on the history of philosophy; Prize for Archæology: Prof. C. Anti, of the University of Padua, for researches on ancient Greek theatres.

Science Service, Washington

At the recent annual general meeting of Science Service, Dr. L. A. Maynard, professor of nutrition and biochemistry of Cornell University, and Dr. Rene J. Dubos, bacteriologist and member of the Rockefeller Institute for Medical Research, New York City, were elected new trustees, being nominated

by the National Academy of Sciences and the National Research Council, respectively. At the same time, the following officers were re-elected: *President*, Dr. Harlow Shapley, director of Harvard College Observatory; *Vice-President and Chairman of the Executive Committee*, Dr. Alexander Wetmore, secretary of the Smithsonian Institution; *Treasurer*, O. W. Riegel, director of Lee School of Journalism, Washington and Lee University; *Secretary*, Watson Davis, director of Science Service. Additional members elected to the Executive Committee were Frank R. Ford, editor, Evansville Press, Evansville, Ind., and Dr. Karl Lark-Horovitz, Purdue University. Science Service is an endowed, non-profit-making institution for the popularization of science. The board of trustees consists of three representatives each from the American Association for the Advancement of Science, the National Academy of Sciences, the National Research Council, the journalistic profession, and the Scripps Estate. The address of Science Service is 1719 N St., N.W., Washington 6, D.C.

An Unusual Solar Halo

Mr. J. E. Bowman, Armament Research Establishment, Fort Halstead, Kent, writes: "On May 10 at Shoeburyness I observed a solar halo of an unusual size. For about the last hour before sunset a well-defined parhelion of the 22° halo was visible to the north of the sun; but there was no trace of the 22° halo itself. Just after the sun had set, however, the upper part of the 22° halo appeared, accompanied by a much smaller halo, the radius of which I estimated to be about 8–9°, and a sun pillar extending to some 15° above the sun. A patch of relatively greater brightness appeared where the sun pillar intersected the 8° halo. The whole spectacle, which lasted until a quarter of an hour after sunset, was extremely faint and could be distinguished only with difficulty. The display of halo phenomena continued after dark, for at 10 p.m. the moon was accompanied by the two paraselenæ of the 22° halo. Again, however, there was no trace of the 22° halo itself."

Co-operation between Universities and Technical Colleges

In his address to a recent meeting of the Yorkshire Council for Further Education, Sir Ronald Weeks, chairman of the National Advisory Council for Education in Industry and Commerce, discussed the need for much closer co-operation between universities and technical colleges (*Tech. J.*, **41**, No. 4; April 1949). Considering the place of the graduate in industry, Sir Ronald said that more attention should be given to the possibility of strengthening the science graduate on the technological side, and the Higher National Certificate student on the science side. Arrangements should also be made whereby graduate students could attend special courses of technology at the technical college either by block release or part-time study. Sir Ronald Weeks suggested certain principles for the provision of arrangements of this kind which must be observed. Among these are the following: both universities and technical colleges must be considered available for meeting the needs, having regard to their present facilities or possible future facilities; the convenience and needs of the students must come first, particularly in the case of part-time students; technical colleges must not be regarded as the poor relations of the universities, as this is fatal to co-operation and good understanding; there must be an easy means of transfer of students from universities to technical colleges, and vice versa.

Earthquakes during March

At least eleven strong earthquakes occurred in the world during March. The greatest, and also the deepest, happened on March 4 from a focus having an epicentre near lat. 36·5° N., long. 70·5° E., in the Hindu Kush, Afghanistan. The depth of focus was probably rather greater than 200 km. and the strength 7½ on the instrumental scale. Owing to its strength and depth, the shock was felt over a wide area in Afghanistan and the North-West Frontier Province, Pakistan, and although the full extent of the damage is not yet assessed, the earthquake is known to have damaged the Roman Catholic cathedral in Lahore. The next most intense (scale *c.* 7) was probably that occurring on March 27 from a focus having an epicentre in the Celebes Sea off the southern coast of Cape Mindanoa. Strong shocks on March 16 and 17 had their epicentres in the region of the Bismarck Archipelago. On March 9 an earthquake with strength 5½ and epicentre near lat. 37·1° S., long. 121·3° W., in central California set off burglar alarms and rolled stones off Telegraph Hill, San Francisco, but did no serious damage. At Hollister some windows and plaster were cracked, and small objects were shaken off shelves. Of the small shocks during the month, three may be mentioned. On March 7 an earthquake was felt with strength 3–4 on the Modified Mercalli scale in the south-west Alps near Messtetten. It had a depth of focus, according to Dr. W. Hiller, of Stuttgart, of less than 5 km. On March 11 a strong tremor shook the area around Dalton, New South Wales, Australia, and cracked buildings there, causing damage estimated at £2,000. The shock was felt in Sydney and Canberra. On March 22 an earthquake was felt in the Département des Basses-Alpes, France, doing some damage at Lauzet. Instrumental readings for the month have been received from the central stations of the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association; the Central Seismological Bureau at Strasbourg; and individual observatories at De Bilt (Netherlands), Durham, Stuttgart and Toledo.

Tellus: A New Journal of Geophysics

The Second World War has brought losses and also gains in the periodical literature of geophysics. Among the gains is *Tellus*, a quarterly journal of geophysics issued by the Swedish Geophysical Society. Vol. 1, No. 1, February 1949, consists of 64 pages, and is obtainable from the Department of Meteorology, University of Stockholm, price 2 U.S. dollars. The Society was founded in 1920 to promote research and international collaboration in geophysics; but the institution of a regular journal is a new departure made possible by a Government grant and by the co-operation of the Lithographic Institution of the General Staff. Contributions, to be printed in English, French or German, are invited on all branches of geophysics, from all countries. The first issue, however, is practically an all-Swedish one, the authors concerned being Pettersson, Rydbeck and Stranz, Palmén, Bergeron, Nyberg, Rossby, Ahlmann, and Ångström. Five of the contributions are meteorological; one is ionospheric, being on the

effects of solar flares; and two relate to marine expeditions, one prospective and the other that of the *Albatross*, to obtain sediment cores to study the geochronology of the deep ocean bed.

Institution of Mining and Metallurgy

THE second Sir Julius Wernher Memorial Lecture of the Institution of Mining and Metallurgy will be given by Dr. C. H. Desch, who will speak on "The Effect of Impurities on the Properties of Metals". The Lecture will be delivered at the Royal Institution, 21 Albemarle Street, London, W.1, on July 6, at 5 p.m., and admission is free and without ticket.

The Institution will be holding a symposium on "The Refining of Non-Ferrous Metals" during July 7–8 at the Royal Institution of Chartered Surveyors, 14 Great George Street, Westminster, London, S.W.1. Tickets of admission (which are free) and further information may be obtained from the Secretary, Institution of Mining and Metallurgy, Salisbury House, Finsbury Circus, London, E.C.2.

Canadian Scholarship Awards

SCHOLARSHIPS have been granted by the National Research Council of Canada to 165 graduates to enable them to pursue postgraduate studies during the academic year 1949–50. There are nineteen fellowships at 900 dollars, sixty-four studentships at 750 dollars and seventy-eight bursaries at 450 dollars tenable at Canadian universities, and four special scholarships at 750 dollars awarded for study outside Canada. The nominal value of all scholarships for the year is 103,200 dollars as compared with the total for last year of 148 scholarships worth 97,050 dollars. Physics is represented by 65, and chemistry, in its several branches, by 59. The remainder are distributed in the other sciences as follows: bacteriology, 1; biology, 4; communications engineering, 1; cytogenetics, 1; electrical engineering, 2; geology, 3; histology, 2; mathematics, 3; medical research, 2; microwave studies, 1; metallurgy, 2; mineralogy, 2; nutrition, 1; physical metallurgy, 2; physiology, 1; radiation studies, 2; spectroscopy, 3; zoology, 8.

Colonial Service: Recent Appointments

THE following appointments in the Colonial Service have been announced: G. Swaine, entomologist, Tanganyika; R. L. Woolridge, veterinary officer, Kenya; E. Pawson, agricultural chemist, Northern Rhodesia; K. L. Richards, livestock officer, Agricultural Department, Cyprus; A. J. Whitaker, electrical engineer, Nigeria; J. L. King (deputy electrical engineer-in-chief, Nigeria), electrical engineer-in-chief, Nigeria; J. M. Stock (senior electrical engineer, Nigeria), deputy electrical engineer-in-chief, Nigeria; J. R. Lockie (conservator of forests, Nigeria), assistant chief conservator of forests, Nigeria; R. Smeathers (assistant conservator of forests, Trinidad), deputy conservator of forests, Trinidad; J. H. Bowen (senior inspector of plants and produce, Gold Coast), chief inspector of plants and produce, Gold Coast; A. H. Fetherstonhaugh (control officer, Game Department, Federation of Malaya), chief game warden, Federation of Malaya; T. P. Lecky (agricultural officer, grade 2, Jamaica), senior livestock officer, Jamaica; W. G. Stuart (agricultural officer, grade 2, Jamaica), agricultural officer, grade 1, Jamaica; C. Teesdale (entomological field officer, Kenya), entomologist, Kenya.

Telecommunications at the Imperial College

STANDARD TELEPHONES AND CABLES, LTD., have endowed a readership, to be known as the Henry Mark Pease readership in telecommunications, in the City and Guilds College of the Imperial College of Science and Technology, London. Henry Mark Pease, one of the pioneers of the telephone industry in Britain, who died in March 1947, was managing director of Standard Telephones and Cables, Ltd., until 1928; he took an active part in forming the British Broadcasting Company, of which he was one of the original directors. Mr. E. C. Cherry has been appointed to the new readership. Mr. Cherry was attached to the Telecommunication Research Establishment of the Ministry of Aircraft Production during the war period and is known particularly for his contributions to the subject of electric circuit analysis.

The British Society for International Understanding

SIR ARTHUR HALL has been elected chairman of the British Society for International Understanding in succession to Mr. G. M. Young, the historian and literary critic, who has retired after holding the chairmanship since the Society's incorporation ten years ago. Sir Arthur Hall is director of studies at the Royal Naval College, Greenwich, and is also chairman of the English Association. Mr. Young remains chairman of the Editorial Committee of the Society's publication, *The British Survey*. Mr. Oliver Bell has been succeeded as vice-chairman of the Society by Colonel John Grace, of British Columbia, formerly director of education of the Canadian Army in Britain during the War.

Linnean Society of London: Officers for 1949

THE following have been elected officers of the Linnean Society of London for the session 1949–50: *President*, Prof. F. E. Fritsch; *Treasurer*, Colonel F. C. Stern; *Secretaries*, Dr. B. Barnes (botany) and Dr. A. Tindell Hopwood (zoology); *New Members of Council*, Prof. A. J. E. Cave, Dr. E. B. Ford, C. C. Hentschel and Dr. C. F. A. Pantin.

Announcements

MR. GEOFFREY MUNDAY, of the South-West Essex Technical College, who has been carrying out research on the temperature variation of the optical properties of gold, has been appointed a research-associate at the Massachusetts Institute of Technology.

A SUMMER SCHOOL IN X-RAY ANALYSIS, somewhat similar to those held in Manchester and Cambridge in previous years, is to be held in Leeds during the period August 29–September 10. Further information can be obtained from Prof. E. G. Cox, Department of Inorganic and Physical Chemistry, University, Leeds 2.

THE French Association for the Advancement of Sciences will hold its sixty-eighth annual congress at Clermont-Ferrand, during July 15–21.

ERRATUM. In a footnote to the communication entitled "Inelastic Scattering of Protons by Magnesium and Aluminium" in *Nature* of May 28, p. 848, the present address of the author, E. H. Rhoderick, is wrongly stated; it should be Department of Natural Philosophy, University of Glasgow.

LETTERS TO THE EDITORS

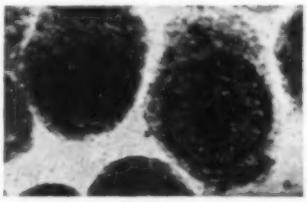
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Absorption of Ultra-violet Light by Living Cells

NUCLEIC acids, because of the presence of purines and pyrimidines in the molecule, absorb ultra-violet light with a maximum absorption at 2600 A. Recently, Larionow and Brumberg[1] suggested, on the basis of ultra-violet light photomicrographic studies, that desoxyribonucleic acid, as it exists in the nuclei of living cells, does not absorb ultra-violet light of wave-lengths near 2600 A. These investigators contended that absorption develops as a result of injury or death of the cell.

Ultra-violet light photomicrographs of living cells made in this laboratory show absorption of light of wave-length 2654 A. Cells of the Walker Carcinoma No. 256 of the rat were used. Cell suspensions were prepared immediately after removal of tumours from the host by mincing tissue finely with scissors in Ringer's solution and straining through a thin layer of cotton to remove coarse aggregates. Cells prepared in this manner and kept for much longer periods of time than was required in these experiments produced tumours when implanted into rats. The cells, in Ringer's solution, were placed on a quartz slide and covered with a quartz coverglass and sealed with paraffin.

Ultra-violet light photomicrographs were made with a quartz optical system microscope by the method previously described[2], with a 2·5-mm. objective, N.A. 0·85 and a 10 × ocular, magnification 240 ×. Condenser diaphragms were closed to small aperture.



Ultra-violet light (2654 A.) photomicrograph of Walker Carcinoma No. 256 of the rat, magnification × 900

Focusing was performed by means of a fluorescent screen and a magnifier with 2654 A. light. The focus was obtained on one area of the field; all light was then barred from the microscope, and the slide was moved to a distant field. In this procedure the cells were exposed to only the amount of ultra-violet light necessary to produce the image on the film. Panatomic X (Eastman Kodak Co.) was used. Photomicrographs made in this manner (see illustration) show the same absorption pattern as those made after the cells have been exposed to several times the amount of ultra-violet light necessary for photomicrographs.

Nuclear and cytoplasmic absorption varied considerably from cell to cell, depending on the metabolic state. Chromosomes, where present, absorbed intensely. In the resting cells the nucleolus usually absorbed much more intensely than did the remainder of the nucleus.

Visual observations of fluorescent images of cells illuminated by ultra-violet light made by rapidly moving the slide across the microscopic field revealed absorption by cells as they came into view; under these conditions exposure to ultra-violet light was less than one second. Chicken erythrocytes in whole blood when observed in this manner within three to five minutes after drawing the blood showed intense nuclear absorption. These observations, which have been repeated many times, indicate that the nucleic acids as they exist in the living cells absorb ultra-violet light. This contention is supported by the work of Wyckoff[3], who made successive ultra-violet (2750 A.) photographs of a living grasshopper spermatocyte and showed absorption by the chromosomes throughout division.

J. O. ELY
M. H. ROSS

Biochemical Research Foundation,
Newark, Delaware.
Dec. 22.

[1] Larionow, L. T., and Brumberg, E. M., *Nature*, **158**, 663 (1946).
[2] Ely, J. O., and Ross, M. H., *J. Franklin Inst.*, **246**, 87 (1948).
[3] Wyckoff, R. W. G., "Symposia on Quantitative Biology", **2**, 39 (1934).

Plant Injury from Phosphorus-32

IT has been generally considered, on the basis of the work reported by Hendricks and Dean[1], that a sufficient margin of safety exists in the tolerance of the plant to radioactivity to permit the use of phosphorus-32 as a tracer in phosphate experiments without fear of any effects on plant growth from the radioactive isotope. The recent communication by Scott Russell and Martin[2], indicating an injurious effect, suggests that a danger exists which requires further study.

In the course of field experiments with wheat in Saskatchewan in 1948, phosphorus-32 was used to follow the uptake of phosphate from seven different fertilizer treatments. Only one row (9 ft. long) in each treatment plot was treated with radioactive fertilizer; but the two immediately adjacent rows were treated with exactly the same amount of the same inactive fertilizer. While this was done to avoid handling large amounts of tracer, and also to check the amount of fertilizer applied with the seed in one row taken up by adjacent rows, the arrangement was ideal for an estimation of effects due to phosphorus-32.

Fertilizer was applied to give P_2O_5 applications of 12, 24 and 48 lb. of P_2O_5 per acre. Two dilutions of phosphorus-32 were used, one at 26 microcuries and the other at 260 microcuries per gram of phosphorus (both measured at time of planting), in connexion with harvests at four different stages of growth. We therefore have information on identical fertilizer treatments, with and without phosphorus-32, at various stages of growth, and at two levels of phosphorus-32 activity. The application of P_2O_5 at 48 lb./acre is the treatment most likely to show injury, since the absolute uptake of phosphorus-32 was highest for this treatment.

Measurements of yield, total phosphorus and phosphorus-32 were made as in previous work[2]. The data are presented below.

Some of the data indicate a small but statistically significant increase as a result of the presence of phosphorus-32. This requires a word of explanation.

(a) Plants harvested at 2–3 weeks; P^{32} applied at 26 μc./gm, P^{31} at time of planting

Phosphate treatment	lb. P_2O_5 per acre	Location *B*			Location *H*		
		% of applied P taken up	Plant wt. (gm./6 ft. row) Active rows	Inactive rows	% of applied P taken up	Plant wt. (gm./6 ft. row) Active rows	Inactive rows
A	12	7·2*	10·9*	10·0	6·5	13·9	10·2
A	24	4·0	10·7	10·8	4·5	16·1	14·6
A	48	3·1	12·3	11·0	3·0	13·7	8·2
B	24	2·9	10·5	10·6	3·8	14·4	11·6
C	24	2·0	9·6	9·8	3·1	14·1	12·4
D	24	0·9	7·6	6·9	0·8	10·7	11·3
E	24	0·5	8·3	7·9	1·1	12·9	10·0
Mean			10·0	9·6		13·7	11·6
L.S.D. 5% pt.			0·8			1·9	

Mean of all treatments, first harvest: active rows, 11·8; inactive rows, 10·4; L.S.D. 5% pt., 1·0
A, $NH_4H_2PO_4$; *B*, NaH_2PO_4; *C*, $CaH_4(PO_4)_2$; *D*, $Ca_4H_2(PO_4)_3$; *E*, $Ca_2H_2(PO_4)_2 + Ca(NO_3)_2$

(b) Plants harvested at various stages: treatment *A*, 48 lb. P_2O_5/acre

Stage	Age in weeks	Activity at planting (μc./gm. P^{31})	Location *B*			Location *H*		
			% of applied P taken up	Plant wt. (gm./6 ft. row) Active rows	Inactive rows	% of applied P taken up	Plant wt. (gm./6 ft. row) Active rows	Inactive rows
Shot blade	2–3	26	3·1*	12·3*	11·0	3·0	13·7	8·2
Heading	5½	26	17·9	69·4	72·5	12·3	72·1	71·2
Soft dough	7½	26	21·1	143·4	139·5	12·4	97·4	86·3
Maturity	11½–12	260	25·0	189·9	189·2	13·6	123·2	124·6
Mean				103·7	103·0		76·6	72·6
L.S.D. 5% pt.				12·0			8·8	

Mean of both locations, all dates: active rows, 90·2; inactive rows, 87·8; L.S.D. 5% pt., 9·6
* These figures are means of four plots. Statistical analysis was by Student's Pairing Method, using the individual figures, rather than means

A little bias at the first harvest at Location *H* resulted from uneven germination. In the original 9-ft. row, 6 ft. were chosen for harvest, taking 6 ft. also from the non-active rows alongside. The active row, which was of greatest interest, was taken to give the most uniform continuous 6 ft. of growth, but occasionally this meant that gaps occurred in the adjacent rows for that particular plot. We do not consider that any real benefit results from the use of phosphorus-32.

The results indicate no signs of harmful effects from phosphorus-32 as used in this experiment. This would confirm Hendricks's and Dean's original conclusion that there is sufficient tolerance to make the avoidance of injury from phosphorus-32 a relatively easy matter, at least for field experiments.

G. Dion
C. F. Bedford
R. J. St. Arnaud
J. W. T. Spinks

Departments of Soils and of Chemistry,
University of Saskatchewan,
Saskatoon.

[1] Hendricks, S. B., and Dean, L. A., Auburn Conference on Use of Radioactive Isotopes, 76 (Edwards Brothers, 1948).
[2] Scott Russell, R., and Martin, R. P., *Nature*, **163**, 71 (1949).
[3] Spinks, J. W. T., Dion, G., Reade, M., and Dehm, J. E., *Sci. Agr.*, **28**, 309 (1948).

Cold Hardiness and Seed Shape in Maize

At least one mid-Western seed company has asserted that 'round-grade' dent corn (maize) seeds withstand more than 'flat-grade' seeds the cold weather after early spring sowings.

Fifty seeds of both kinds of six single-cross and one double-cross hybrids were used to test this. These were kindly supplied by Mr. H. Everett. Seeds were placed in seed-boxes containing soil and lightly covered with it. Two rows of round seed were followed by two rows of the corresponding flat seeds of each hybrid, approximately twenty-five seeds per row. Treatment was by the method of Haskell[1]. The seed-boxes were placed in a 50° F. room and watered when necessary. After eight days they were removed to a warm greenhouse. Maximum germinations were recorded.

Behaviour of round and flat dent corn seed subjected to 50° F. for 8 days

Pedigree	Round			Flat		
	Av. wt. of 10 seeds	% germ.	Angular germ.	Av. wt. of 10 seeds	% germ.	Angular germ.
	(gm.)			(gm.)		
267 × 263·5	4·37	92	73·6	3·58	98	81·9
274 × 263·5	4·68	86	68·0	3·83	88	69·7
251 × 450·6	3·74	100	90·0	3·12	90	71·6
277 × 275	3·73	64	53·1	3·05	80	63·4
268 × 263·5	4·03	84	66·4	3·59	78	62·0
284 × 283	3·92	44	41·6	3·37	50	45·0
Conn 520	—	8	16·4	—	28	31·9
		Mean	58·4		Mean	60·8

The accompanying table gives the values in percentages and angles; the average weight of ten seeds of each type is also given. Germinations of round and flat seeds are very similar, even though round ones are somewhat heavier than flat seeds. An analysis of variance was made on the angular values. χ^2 values were obtained by dividing the sum of squares by the theoretical variance, given by 820·7/50. Each χ^2 had a significantly low probability, especially that for error, or variation within the series. Therefore, using the error mean square, values of t were also obtained.

For flat and round seeds, $t_{[6]} = 0{\cdot}55$, which is not significant. Variation between strains gives $V.R. = 12{\cdot}9$, which has a probability P of $< 0{\cdot}01$, suggesting differential behaviour between the hybrids. How-

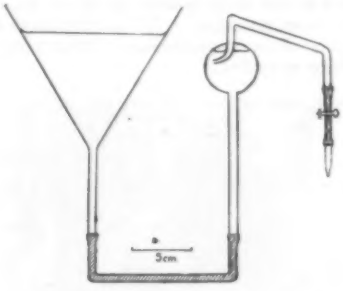
ever, in view of the high value of χ^2 for the error item, it would seem that there is an indirect effect due to the round/flat condition which may be due to some linked quality associated with this difference, rather than to an immediate effect.

GORDON HASKELL
John Innes Horticultural Institution,
Merton Park, S.W.19.
Dec. 3.

[1]Haskell, G., *Science*, **147**, 150 (1948).

Continuous Sedimentation for the Concentration of Trematode Eggs in Fæcal Suspensions

METHODS of concentration for helminth eggs, such as centrifuging with sodium chloride or zinc sulphate solutions and looping off the surface, or the Gordon – Whitlock egg-counting technique for nematode eggs in sheep fæces, cannot successfully be used for trematode eggs because these collapse in hypertonic solutions owing to their thin shells. The use of chemicals and even the mere act of centrifuging may damage the eggs and render subsequent culture unsuccessful. Multiple sedimentation of fæcal suspensions is laborious and time-consuming. The apparatus shown in the sketch will wash away the colouring matter and reduce the fæcal debris to less than half with the loss of only very few eggs. The resulting suspension is of a consistency which will greatly facilitate other operations, such as dilution egg-counts and straining through bolting silk.



This apparatus has been used successfully with sheep fæces for the concentration of trematode eggs. The apparatus is filled with water, except for the air lock in the bowl of the 'distillation splash head', and a suspension of the fæces in water, after having been passed through a 40-mesh per inch sieve, is placed in the funnel. The spring clip is released and the fæcal suspension siphons over; the heavier particles and eggs settle in the bowl. When the operation is almost completed, the funnel is washed round with a few c.c. of water. Recovery of the eggs is easily effected by disconnecting the tubing from the funnel and running the suspension, after agitation, from the splash head into a vessel.

With 6 gm. of fæces in 200 c.c. water and using a splash head with bowl of 4·5-mm. diameter, an escape jet which passes 30 c.c. of water in 1 min. was found to be the most successful. The rate of flow can be adjusted by using different escape jets, and may conveniently be graded according to the number of c.c. which pass per minute.

Examples of egg recovery using 6 gm. of fæces from sheep infected with trematodes

Trematode	No. of c.c. per min. passed by jet	Eggs recovered	Eggs lost
Fasciola hepatica	30	541	6
		252	16
		85	7
		723	11
		647	30
	40	229	16
Paramphistomum cervi	30	66	Nil
		87	Nil
	40	106	4

This apparatus may possibly be of use for other suspensions of eggs in water. It has not proved satisfactory, however, for strongyle eggs; the specific gravity in this case is too near that of water.

J. W. G. LEIPER
Department of Parasitology,
London School of Hygiene and Tropical Medicine,
Field Station, St. Albans, Herts.
Dec. 9.

Effect of Young Grass in the Diet on the Onset of Sexual Maturity in Mice

THE superior nutritive qualities of spring grass as compared with the autumn growth or aftermath, etc., have been attributed to a better and more varied supply of basic nutrients (for example, amino-acids) in the former[1]. While there is undoubtedly some truth in this, it has been slowly realized that the phenomenon may be more complex, and that there are factors in young grass which influence the endocrine system in such a way as to have a direct bearing on productivity (growth, meat and milk) as well as on reproduction (œstrous cycle)[2].

We wish to report some preliminary work (spring, 1947) on laboratory animals which may have a bearing on these problems. Young female mice were placed, immediately after weaning, in three groups on the following diets: (1) Basal diet (B.D.H. light white casein 20 parts, sucrose 60 parts, arachis oil 15 parts, B.D.H. salt mixture 3 parts and dried yeast 10 parts). (2) Basal diet with a supplement (*ad lib.*) of fresh grass cuttings. (3) Basal diet supplemented with dried grass.

All the animals were dosed with tocopherol and radiostoleum. There were twelve mice in each group, and their growth curves and the onset of maturity, as indicated by the opening of the vagina, were noted.

Group	Mean age (days) at vaginal opening	Average weight (gm.) at start of experiment	Average weight (gm.) 45 days old
1. Basal	51 ± 3·7	9·1	19·9
2. Basal and fresh grass	41 ± 4·0	10·1	20·5
3. Basal and dried grass	43 ± 5·0	9·4	19·7

The growth curves in the three groups did not differ appreciably; but the onset of sexual maturity was markedly hastened in the mice receiving a supplement of grass in their diet.

Folley *et al.*[3] have given evidence of the presence of œstrogenic substances in grass by the injection of certain extracts into immature mice. It seems from our preliminary work that laboratory animals such as mice, by natural feeding on a diet in which young grass has been included, do respond as if they

were getting a continual small supply of 'œstrogenic substances' from the diet. Bennetts *et al.*[4] demonstrated that sheep grazing a pasture of subterranean clover could ingest sufficient substance of this type to bring about symptoms of œstrogen hyperactivity. The work of Phillips *et al.*[5] directs attention to the effect of climatic conditions on the distribution of both the rate of calvings and of lamb-weights in West Wales. It seems that climatic conditions affect farm animals both directly, and indirectly, through the pasture. Apart from the general basic nutritive differences, it is possible to predict that factors such as the above should be taken into account in assessing these problems.

I. Antice Evans
W. Charles Evans

Department of Animal Health,
University College of Wales,
Aberystwyth.
Dec. 14.

[1] Morris, S., and Wright, N. A., *J. Dairy Res.*, **4**, 177 (1933); **5**, 1 (1934). Morris, S., Wright, N. A., and Fowler, A. B., *ibid.*, **7**, 97 (1936).

[2] Friedman M. H., and Friedman, G. S., *Amer. J. Physiol.*, **125**, 486 (1939). Friedman, M. H., and Mitchell, J. W., *Endocrin.*, **29**, 172 (1941). Mitchell, J. W., Borasky, R., and Bradbury, J. T., *ibid.*, **31**, 283 (1942). Bodenheimer F. S., and Sulman, F., *Ecology*, **27**, 255 (1946).

[3] Bartlett, S., Folley, S. J., Rowland, S. J., Curnow, D. H., and Simpson, S. A., *Nature*, **162**, 845 (1948).

[4] Bennetts, H. W., Underwood, E. J., and Shier F. L., *Aust. Vet. J.*, **2**, 2 (1946).

[5] Phillips, R., and Davies, J. L., *Nature*, **160**, 429 (1947). Phillips. R., "Fat Lamb Production in West Wales" (unpublished).

The Tricarboxylic Acid Cycle in Nematode Parasites

In nematode parasites the anaerobic breakdown of glycogen to pyruvate and lactate with a consequent formation of adenosine triphosphate follows a course similar to that in vertebrate muscle[1]. Since it appears that aerobic mechanisms may play an important part in the metabolism of certain nematode parasites[2], studies on the carbohydrate metabolism of the parasites have been extended to include some aspects of the oxidative utilization of pyruvate. The organisms used were *Ascaridia galli* from the chicken small intestine and *Nematodirus spathiger* and *N. filicollis* from the sheep small intestine. Some experiments were also carried out with *Neoaplectana glaseri*, a parasite of the Japanese beetle, which, however, was grown *in vitro* for the present experiments. Owing to its relatively large size and its position in the host, *A. galli* may not have an active aerobic metabolism *in vivo*. However, it has been shown that *Nematodirus* spp. probably respire actively *in vivo*, and oxygen is essential for the survival *in vitro* of *Neoaplectana glaseri*.

Experiments were carried out using brei prepared from whole parasites suspended in Krebs – Ringer phosphate buffer at *p*H 7·3. The results were not appreciably affected by omitting calcium from the medium. Oxygen consumption at 38° C., determined by the 'direct' method of Warburg, varied somewhat with different lots of parasites, but Q_{O_2} values (μl. of oxygen taken up per hour per mgm. dry weight, taken over the first period of 30 min.) were usually in the region of 3·8 (*Nematodirus* spp.), 4·0 (*Neoaplectana glaseri*), or 4·2 (*A. galli*). Cytochrome *c* or methylene blue increased oxygen uptake, and, as a routine measure, experiments were carried out with the brei in *M*/3,000 methylene blue.

Co-factors such as co-carboxylase, coenzymes I and II, pantothenate, riboflavin, nicotinic acid and pyridoxine did not markedly affect the oxygen uptake. However, in increasing order of activity the substrates pyruvate, malate, α-ketoglutarate, fumarate and succinate, at concentrations of *M*/100, all caused increased oxygen uptake. Oxalacetate (*M*/1,000) caused a stimulation of the same order as pyruvate. Citrate (*M*/100) had little effect. These results suggest that some form of Krebs tricarboxylic acid cycle was functioning in the parasite tissues. However, compared to pigeon breast muscle, the parasite tissue was relatively insensitive to malonate. Further, results taken over the first 30 min. of an experiment always showed that malonate inhibition was *increased* in the presence of added succinate. When the period of observation was confined to the first 10 min. of the experiment, the effect of succinate on malonate inhibition was less marked; but as a rule, as shown in the accompanying table, inhibition was *increased*. Pyruvate, fumarate and malate, at concentrations of *M*/100, all markedly reduced the inhibition caused by *M*/50 malonate. One interpretation of these results would be that, though a form of the Krebs tricarboxylic acid cycle is functional in the parasite tissues, succinate oxidation, relative to the total oxidative activity, is less important than in pigeon breast muscle.

Effect of malonate and succinate on the oxygen consumption of brei from pigeon breast muscle and nematode parasites. The figures give the percentage inhibition found during the first period of 10 min.

Conditions	Pigeon breast muscle	*Nematodirus* spp.	*Ascaridia galli*	*Neoaplectana glaseri*
Malonate, *M*/100	50–70	25	11	8
Malonate, *M*/100 + succinate, *M*/100	—	40	43	16
Malonate, *M*/1000	30	0–10	0–10	0
Malonate, *M*/1000 + succinate, *M*/1000	5			

The difference in the reaction of the parasite tissues and pigeon breast muscle to malonate was also examined by determining the accumulation of succinate, by the method of Krebs[3], in brei from the different organisms which had been incubated for 1 hr. at 38° C. In the absence of malonate, no succinate was found in the parasite preparations and very little in the breast muscle. However, in *M*/100 malonate, succinate accumulated in the muscle brei but still was not found in the parasite material. Even when *M*/100 malonate and *M*/100 fumarate were added to the parasite brei, succinate accumulation did not occur or was very small indeed.

A detailed account of this work, which was part of the research programme of the Division of Animal Health and Production, Council for Scientific and Industrial Research, will be published elsewhere. A note on the nature of substrates, other than those of the Krebs tricarboxylic acid cycle and the mechanism by which they are metabolized by the parasites, will be published shortly.

Vincent Massey
(Ian McMaster Fellow)
W. P. Rogers

McMaster Laboratory,
Division of Animal Health and Production,
C.S.I.R., Sydney.
Nov. 26.

[1] Rogers, W. P., and Lazarus, M., *Parasitology* (In the press).
[2] Rogers, W. P., *Nature* [163, 879 (1949)].
[3] Krebs, H. A., *Biochem. J.*, **31**, 2095 (1937).

Yellowing Disease of 'Family 41' Sugar Beet

In a preliminary note[1], Clinch, Loughnane and McKay describe a yellowing disease in a breeder's 'pure line' of sugar beet (family 41), which is transmissible through the seed and also by the aphis, *Myzus persicæ*. Recently, Clinch and Loughnane have published a paper[2] on this disease with the title "Seed Transmission of Virus Yellows of Sugar Beet and the Existence of Strains of this Virus in Eire". This title is, in our opinion, misleading, for it suggests that sugar beet yellows virus is transmitted by seed. There is, on the contrary, much evidence that it is not, and though the yellowing of family 41 may be transmitted through the seed, there is nothing to show that the condition is caused by beet yellows virus.

Clinch and Loughnane's conclusion that the yellowing disease of family 41 is beet yellows virus is based solely on symptomatology, particularly on the accumulation of carbohydrates in the yellowed areas of the leaves. However, this is by no means specific to beet yellows virus, nor to virus diseases, for leaves yellowed by downy mildew (*Peronospora schachtii*) are abnormally high in carbohydrate.

In family 41 the symptoms somewhat resemble those of sugar beet yellows; but in field conditions many plants, particularly those which do not inherit the disease, but become infected later, show important distinguishing features. The chlorotic areas are pale; the outlines finely indented with sharply defined lobes and scattered chlorotic spots. With sugar beet yellows the yellowing is brighter, and the outlines of the chlorotic areas are not sharply defined unless bounded by veins. When the disease from family 41 is introduced into other varieties of sugar beet, the symptoms are very weak and ephemeral. Often only one leaf per plant shows any definite yellowing or thickening, and when this leaf dies the plant may be indistinguishable from a healthy one.

Clinch and Loughnane state that the cause of the yellowing in family 41 is transmitted by *M. persicæ* to other sugar beet varieties as readily as mild strains of beet yellows virus. We have not been able to confirm this. Using 10–20 aphides per plant and long feeding times (at least 48 hours on infected and healthy plants) we have never been able to obtain more than 10 per cent of infection in commercial varieties, and often there appears to be no transmission at all. Kleinwanzleben 'E' plants grafted with yellowed plants of family 41 remained apparently healthy. The mild strains of beet yellows virus which we have used[3] are transmitted by comparatively small numbers of aphides after a few hours of feeding.

Sap from plants infected with our mild strains of beet yellows virus is precipitated by antiserum prepared against the severe strains, but saps from yellowed plants of family 41 are not.

Much evidence will be needed before the relationships, if any, between the cause of the yellowing in family 41 and sugar beet yellows virus are understood; but the fact that some seedlings of family 41 have a transmissible chlorosis does not in any way affect the control of sugar beet yellows. There is no reason to consider that beet yellows is transmitted in the seed of any commercial variety of sugar beet; nor is there yet any evidence that the cause of the yellowing in family 41 is transmitted by seed in any of these varieties. Indeed, there is no evidence that the cause of the yellowing in family 41 resulted, in the first place, from seed transmission in the normal sense, because it is not known that the parent plants were infected with beet yellows or with any other virus. The phenomenon could be explained on the more interesting hypothesis that the yellowing shown by plants of family 41 has originated in that particular genotype. The sharp definition of the chlorotic pattern suggests an analogy with variegation arising from plastid mutation such as that of maize, described by Rhoades[4]. It suggests also that, if the cause is a virus, it moves with unusual difficulty from cell to cell. This hypothesis might explain the difficulty in infecting sugar beet varieties that regularly become systemically infected with sugar beet yellows.

M. A. Watson
R. Hull
Rothamsted Experimental Station,
Harpenden, Herts.

K. Hartsuijker
Wageningen, Netherlands.
(Formerly Institut voor rationele suikerproductie, Bergen op Zoom.)

[1] Clinch, P. E. M., Loughnane, J. B., and McKay, R., *Nature*, **161**, 2 (1948).
[2] Clinch, P. E. M., and Loughnane, J. B., *Proc. Roy. Dublin Soc.*, **24**, 307 (1948).
[3] Watson, M. A., *Proc. Roy. Soc.*, B, **835**, 535 (1940).
[4] Rhoades, M., *Proc. U.S. Nat. Acad. Sci.*, **29**, 327 (1943).

Movement of Zooplankton in Diatom Gradients

Hardy and Gunther[1] and Harvey *et al.*[2] have proposed somewhat opposing hypotheses in explanation of a phenomenon widely observed in the sea, namely, an inverse correlation in catches of zooplankton and phytoplankton. Hardy's hypothesis, that of "animal exclusion", is supported in some degree by the experimental work of Lucas[3]; and Harvey's, of the "grazing effect of zooplankton", by various observations on rates of feeding, and statistically by Fleming[4] and others.

The apparatus illustrated in Fig. 1 was devised in order to determine experimentally the behaviour of zooplanktonts when presented, under certain

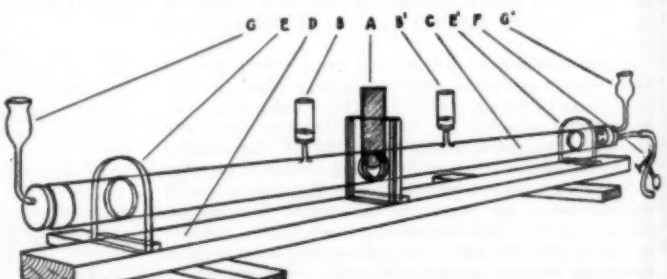


Fig. 1. Perspective view of apparatus. *A*, Sliding door (half open); *B B'*, entrance tubes for animals; *C*, glass tube; *D*, wooden base; *E E'*, 'Perspex' supports; *F*, draining tube with clip; *G G'*, filling funnels for diatom culture

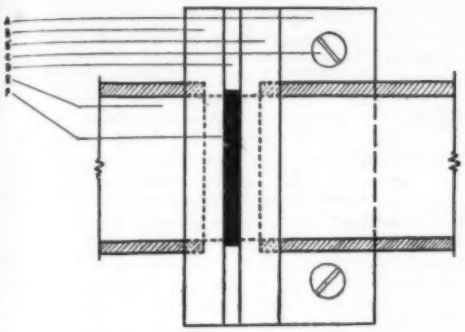


Fig. 2. Working plan of door component. *A*, 'Perspex' supporting bracket; *B B'*, 'Perspex' cheeks recessed for tube; *C*, securing screw; *D*, 'Perspex' spacing piece; *E*, terminal part of glass tube; *F*, sliding door

conditions, with a choice between concentrated diatom cultures and sea water. It consists of a cylindrical glass tube of *c.* 40 in. length and 1 in. diameter, divided in the centre by a removable transparent 'Perspex' sliding door and carrying tubes and funnels for the introduction of cultures and animals. Into one side of this apparatus were put cultures of *Nitzschia closterium* (Plymouth strain) grown in sterilized sea water enriched with Allen and Nelson's[6] modification of Miquel solutions. Into the other was put enriched but otherwise pure sea water. Upon opening the sliding door, a visible gradient of diatoms was set up, usually in about the central third of the apparatus, although its length varied with the conditions of the experiment. Zooplanktonts were then introduced in equal numbers into each side and their distribution recorded at intervals for from 1½ hr. variously up to two days. The gradients cannot be observed after about thirty-six hours as movement of the animals tends to destroy them.

Using *Neomysis vulgaris* taken from the River Humber, twenty-eight experiments were performed; eleven with diatoms adapted to growth in 50 per cent sea water and seventeen with 100 per cent sea-water cultures diluted to 50 per cent just before the experiment. No excluding effect of the diatoms could be demonstrated; but a vigorous and often total movement of animals into the diatom side of the apparatus occurred. This movement was most marked with starved individuals and least with fed ones. There was no movement into water immediately filtered from a growing diatom culture, nor was it invoked with water coloured to simulate diatom culture (using pigments shown independently not to be inimical to these mysids), and it did not occur in the dark. There was movement into freshly taken river water (17·5 per thousand salinity) in which living diatoms filtered from a culture had just previously been suspended. Finally, diatoms from a culture were killed by heating to 80° C. for about twenty minutes, filtered off, washed three times on the filter and resuspended in river water. Undiminished movement into this suspension occurred. The number of animals used in each experiment was sixteen, and the diatom cultures were of a concentration of about 1,000 cells per c.mm.

Restricted experiments with *Eurytemora hirundoides* and *Macropsis slabberi* gave similar results, and the movement has also been demonstrated, less effectively, in a vertical apparatus.

The movement of the animals under these conditions seems to be dependent upon the physical presence, in the light, of the diatoms on which they are feeding. These observations provide no evidence in support of Hardy's exclusion hypothesis. It is emphasized, however, that only estuarine animals have been used and that the natural distributions of these particular species have never been shown to be inversely correlated with the occurrence of phytoplankton. The rate of movement of individuals in the horizontal tube, however, was of such an order (*c.* 2 yards per minute) as to be of importance should it be sustained in a constant direction in the sea. It could, were the hypothesis of Harvey correct, be a contributory factor in the production of the grazing effect.

It is intended to apply the technique to an investigation into the relationships of other diatoms and open-sea animals, but this will not be possible for some months, for which reason this preliminary note is now submitted.

R. Bainbridge

Department of Zoology,
University College,
Hull.
Dec. 30.

[1] Hardy, A. C., and Gunther, E. R., "Discovery" Rep., **11**, 1 (1935).
[2] Harvey, H. W., Cooper, L. H. N., Lebour, M. V., and Russell, F. S., *J. Mar. Biol. Assoc. U.K.*, **20**, N.S., 407 (1935).
[3] Lucas, C. E., *J. Cons. int. Explor. Mer.*, **11**, 343 (1936).
[4] Fleming, R. H., *J. Cons. int. Explor. Mer.*, **14**, 1 (1939).
[5] Allen, E. J., and Nelson, E. W., *J. Mar. Biol. Assoc. U.K.*, **8**, N.S., 421 (1910).

Keeping Lampreys Alive

It has come to my notice that others working on lampreys have had, like myself, difficulty in keeping them alive. Since I have been successful both this year and last in keeping the river lamprey or lampern (*Lampetra fluviatilis*, L.) alive over long periods, the following observations may be of interest.

The essential requirements would seem to be: (1) a liberal supply of oxygen, (2) a means of keeping the temperature of the water below 15° C., (3) absence of direct light.

If the water cannot be artificially aerated, a small number of lampreys (not more than twelve) can live quite well in still water 5 cm. deep providing there is a surface area of not less than 2 square metres. If the depth of water is increased, the lampreys very quickly die from lack of oxygen. Mains water running into a sink with a high overflow often kills lampreys within half an hour.

My stock tank in which I am keeping more than one hundred lampreys measures 7 ft. × 2½ ft. × 3½ ft., and it has 12 in. of water which is kept in constant circulation by a 24-V. D.C., ex-R.A.F. turbine (petrol) pump at one end of the tank, which delivers the water to the top of an aerating tower at the opposite end of the tank at the average rate of 2 litres per minute. The water falls over a series of louvres covered with chicken grit which offers a total surface area of approximately one square metre. The water takes 15 sec. to pass through the tower, the bottom of which is one foot above the level of the water in the tank below.

If the circulation is stopped for as little as one hour, the lampreys are seen to be in respiratory distress, breathing is rapid (more than 200 per minute) and shallow, the lampreys fall over on their sides and are unable to right themselves or to grip with

their sucker. If the circulation is then restarted, the lampreys recover completely within two or three hours.

My tanks are of heavily galvanized iron and rest on a stone floor in a basement room which is kept cool by a through draught of air. Last winter the outside windows were closed in error one week-end. This caused the temperature of the water to rise from 13° C. to 22° C., and despite the fact that the water was still circulating all the lampreys had died.

The high sides of the tank cut out direct light and keep the lampreys from jumping out when they are being netted.

Details of the apparatus and experiments will be published elsewhere.

Note added in proof. The pump mentioned above has since been replaced by a ½ h.p. A.C. centrifugal pump which needs little servicing.

E. W. Baxter

Department of Biology,
Guy's Hospital Medical School,
London, S.E.1.
Jan. 3.

Feeding-Rates of Sponges, Lamellibranchs and Ascidians

Many water-living animals obtain their food from suspended material, micro-organisms or fine dispersed detritus occurring in the surrounding water. Sponges and ascidians, for example, are typical filtering animals. Most lamellibranchs belong to the same group. But filtering forms may also be found among gastropods, crustaceans, insects, polychætes, vertebrates, etc. Apart from lamellibranchs, little information is available regarding the rate and efficiency with which particles are retained from water passing the filtering organs. Bidder[1] calculated the water propulsion through *Leucandra aspersa* (a sponge), whereas investigations on the rate of feeding of ascidians seems to be lacking. During a stay at the Plymouth Laboratory, I was offered an opportunity of determining the feeding-rates of species of sponges and ascidians. The feeding-rates have been calculated from the rate of disappearance of particles from the surrounding water[2]. Suspensions of colloidal graphite were used, namely, 'Prodag' grade C and 'Aquadag' grade S, manufactured by E. G. Acheson, Ltd., London; the former has an average particle size of 4–5 μ, whereas the latter has an average particle-size of 2 μ. The concentrations of the graphite suspensions were determined photometrically by means of a portable Eel photometer.

The results of the experiments are given in the accompanying table. The feeding-rates are expressed as per mgm. of amino-nitrogen of the experimental animals instead of the normally used weight and length or similar measurement, which provide an unsatisfactory basis for comparisons between animals. In the table are also included results obtained on *Mytilus edulis*, which will be published in greater detail elsewhere[3]. It is seen that—when expressed in relation to the amino-nitrogen content, which may be regarded as a measure of the amount of protoplasm in the animals—the feeding-rates of the species investigated are all of the same order of magnitude, *Halichondria* and *Mytilus* showing somewhat lower values. However, the experiments on *Halichondria* were carried out on a fragment weighing about 50 gm., whereas the calcareous sponges used were all smaller intact specimens.

Species	Number of animals in each experiment	Length (cm.)	Average content of amino-nitrogen (mgm.)	Feeding-rate ml./hr., per mgm. amino-nitrogen
Ascidians				
Molgula sp.	20	1–2	1·8	138, 124, 285, 118, 149, 115
Ciona intestinalis (L.)	2	6–7	6	125, 92, 104
,, ,, ,,	3	6–7	5·3	125
Sponges				
Grantia compressa (Fabricius)	1	7	8·5	135
,, ,, ,,	9	3–7	3·3	180
Sycon coronatum (Ellis and Solander)	9	4–6	2	200, 145
Sycon + *Grantia*				170
Halichondria panicea (Pallas)				65
Lamellibranchs				
Mytilus edulis (L.)		c. 3	25	36
,, ,, ,,		c. 1·5	2	80

The feeding-rates of sponges and ascidians were found to be independent of the particle-size, which varied from about 2 μ and 4·5 μ respectively and upwards. The upper limit of the particle-size in the suspensions was not known, as the graphite did not form fully dispersed suspensions in sea water. A certain amount of aggregated particles was always observed when the suspensions were examined under the microscope.

As regards the ascidians, the independence of feeding-rate and particle-size is in good agreement with the view held by MacGinitie[4] concerning the feeding mechanism of ascidians. He observed that ascidians when feeding are covering the gill basket with a continuous layer of mucus which retains all particulate matter in the water transported through the gills.

My thanks are due to the director, Wing-Comdr. F. S. Russell, for placing the working facilities of the Plymouth Laboratory at my disposal, and for his great interest in my work. The investigations were made possible through a grant from the Rask-Ørsted Foundation.

C. Barker Jørgensen

The Laboratory, Plymouth,
and
Zoophysiological Laboratory,
University of Copenhagen.
Nov. 24.

[1] *Quart. J. Mic. Sci.*, **67**, 293 (1923).
[2] Jørgensen, Barker, *Acta physiol. Scand.*, **5**, 297 (1943).
[3] *J. Mar. Biol. Assoc.* (in the press).
[4] *Biol. Bull.*, **77**, 443 (1939).

Varagu Poisoning

Varagu (Tamil), *kodo*, *kodaka* (Hindustani), *Paspalum scrobiculatum* (Linn.), is a millet largely used by the working and poorer classes of people in all parts of India as a staple article of food. More than 300,000 tons of this millet is produced in the Madras Presidency alone. In 1946, when rice was rationed and millet eaters were compulsorily asked to take a portion of their requirements in rice and millets in the form of *varagu*, complaints were received that consumers in several parts of the Presidency developed symptoms of food poisoning as a result of eating *varagu* in the cooked as well as the raw state.

The symptoms observed within twenty minutes of taking the food were tremors, giddiness, perspiration, inability to speak or swallow. There were no fatalities, and the symptoms disappeared after twenty-four hours, though the persons affected had to be taken to hospital for treatment.

It was difficult to feed monkeys, as they refused to take the food. Two ounces of the millet produced the same symptoms on dogs; tremors and paralysis were characteristic effects, and the dogs died in twenty-four hours. The Stas Otto test was negative, showing the absence of alkaloids. The fat was extracted with petroleum ether (60–95° C.), or chloroform, or ether, and it was found that 1·5 gm. of fat corresponding to 50 gm. of the millet were fatal to dogs. The fat had the following figures (average):

Melting point	42° C.
Refractive index (60° C.)	1·4650
Iodine value	93·6
Saponification value	170·7

The defatted residue was found to be non-toxic. The poison in the fat seems to be decomposed by dilute acid and alkali, as after acid and alkali treatment the treated fat is no longer poisonous. The liquid, decanted after shaking the millet with petroleum ether, develops a characteristic red colour when shaken with concentrated sulphuric acid. But as the fat in the millet after treatment with dilute acid—when it is no longer poisonous—still gives the colour test, it is inferred that the colour observed is not due to the poison in the fat but to a decomposition product of it. The poison seems to be neither an alkaloid nor a glucoside, as it is not extracted with acid, water or 90 per cent alcohol. It seems to be adsorbed chromatographically in silica column. Further work is in progress.

The fat obtained from non-poisonous varieties of *varagu* is quite harmless, and does not give the sulphuric acid test described above.

The most surprising observation is that the fat derived from the poisonous variety develops symptoms of poisoning in dogs and monkeys when injected intramuscularly, 1 gm. of the fat being fatal. Crows seem to be extremely susceptible to the poison in the fat, either when ingested orally or injected intramuscularly. Within ten minutes of oral ingestion, the crow puts down its beak and vomits; even after all the contents have been vomited the crow puts down its beak in an effort to vomit. It loses the mobility of its eyes and soon its power of using its legs, while the wings are spread out and can no longer be brought together. The crow dies in twenty-four hours. The effects are slow when the fat is given by injection; but the collapse is more pronounced and the symptom of vomiting, even when there is nothing to vomit, is a characteristic of the poisoning in the crow.

These observations do not appear to have been recorded so far in the literature. They give a means of distinguishing the poisonous from the non-poisonous variety, and it should lead to the reclamation of an important article of food which, of late, has come into disrepute owing to the ill-effects attending its consumption.

K. V. Sundaram Ayyar
K. Narayanaswamy

Government Analyst Laboratory,
Guindy, Madras.
Dec. 3.

Rh Phenotypes and Fisher's *CDE* Notation

Since the introduction of Fisher's theory and notation[1] of the *Rh* blood-group system, the tendency has been to express phenotypes in terms of the probable genotype. This method is most convenient for European populations, where every common phenotype consists very largely of a single genotype; but its extension to non-European populations usually involves serious ambiguities. In this and other connexions, there is an undoubted need for an unambiguous and generally understood phenotype notation expressed in Fisher's symbols, which would be available to supplement current practices. Several attempts have been made to express phenotypes with the use of these symbols, probably the earliest being that of Bushby[2]. The present proposals closely resemble those of Bushby; but allowance is here made for the fact that the six typing sera (anti-*C*, *D*, *E*, *c*, *d*, *e*) are not usually all available as Bushby tacitly assumes. No originality is claimed for these proposals; it is probable that other workers have thought of and used them independently; and, in fact, when recently I was discussing an *Rh* problem with Dr. M. Bessis of Paris, we found that we had both for some time been using this system in working out *Rh* problems.

The phenotype formula is derived as follows: considering first the *C* locus of Fisher, if a specimen of blood has been tested with anti-*C* alone and the result is positive, a single *C* is written. If the result is negative, *cc* is written, whether or not the blood has been tested with anti-*c*, since a negative result with anti-*C* indicates the presence of two *c* genes. If the blood has been tested with anti-*C* and anti-*c* and both give positive results, *Cc* is written. If the result with anti-*c* is negative, *CC* is written, and this can be done even in the absence of a test with anti-*C*. The *D* and *E* systems are treated similarly. But if both the antisera required for one particular system (for example, *Ee*) are unavailable, the statement of the results (for example, *Ccdd*) makes this quite clear. To take a concrete example, let it be supposed that blood of the genotype *CDe/cde* is being tested with the commonest four antisera, namely, anti-*C*, anti-*c*, anti-*D* and anti-*E*, the results will, in that order, be + + + − and the phenotype will be written *CcDee*. The only available information which is missing from this expression of the results is as to whether the blood has been tested with anti-*e*; but the negative result with anti-*E*, in fact, makes such knowledge irrelevant. The absence of a second *D* symbol (*D* or *d*) shows that no test has been done with anti-*d*.

The above suggestions only relate to the common antigens *C*, *D*, *E*, *c*, *d*, and *e*, in respect of which all the suggested conventions appear self-evident. In order to deal with the rarer alleles such as C^w, it would be necessary deliberately to adopt certain further conventions by agreement between the workers concerned.

A. E. Mourant

Blood Group Reference Laboratory,
Ministry of Health,
Lister Institute of Preventive Medicine,
Chelsea Bridge Road,
London, S.W.1.
March 4.

[1] Fisher, R. A., personal communication cited by Race, R. R., *Nature*, **153**, 771 (1944).
[2] Bushby, S. R. M., *Lab. J.*, **8**, 78 (1946).

Triassic Plant Remains from the Salt Range in the Punjab

DR. SITHOLEY[1] has described some "bivalved structures" from the Triassic of the Salt Range in the Punjab, which he says "are remarkably like the alga *Cosmarium*"; but he admits that "the latter is far too small to be compared with them". He then compares these structures to Arnold's Greenland organism "undergoing fission". From his description and the photographs, however, I was inclined to think that these structures could best be compared with some two-winged spores, with which they agree both as regards their size and their shape and general appearance.

With the view of confirming my doubts, I examined some of Dr. Sitholey's beautifully coloured specimens which he was kind enough to show me, and I am now convinced that this so-called "most intriguing type" should be referred to *Pityosporites* Seward, a spore form which was fairly common in the Lower and the Upper Gondwana floras[2]. Similarly, the "disc-like bodies" (Sitholey, *loc. cit.*, p. 322, and photos 58–60) found in "fairly large numbers" are, I believe, one-winged spores with a central body and a peripheral bladdery wing forming the "thick wing" (due to the formation of a cast of the air cavity). Similar one-winged spores are one of the commonest types in the Lower Gondwana beds[3]. Dr. Sitholey, while mentioning that these might be "some kind of spores", adds that "there is no real proof of their organic nature"; but it might be said that the proof is as good for these as it is for the other types which have been referred by him to the spore genera *Triletes* and *Sporites*.

It seems that the conditions of fossilization, at this spot, were very suitable for the formation of casts, and they have been formed even in the case of such minute structures. The occurrence of almost identical two-winged, one-winged and other spores (*Triletes*, *Sporites*, etc.) in the immediately preceding Lower Gondwana beds not only confirms the above conclusions but also might perhaps indicate some relationship between these two floras, a thing which is in accord with the views of Seward and Sahni[4]. The relative frequency of the various types of spores in the two floras has, however, to be determined before this can be said with any certainty.

D. D. PANT

Botany Department,
University of Allahabad.
Dec. 24.

[1] *Proc. Nat. Acad. Sci. Ind.*, 322 and photos 65–70 (1943).
[2] Virkki, *Proc. Ind. Acad. Sci.* (1937); *Proc. Nat. Acad. Sci. Ind.* (1946). Seward, Brit. Antarctic Exp. 1910 (Nat. Hist. Rept. 1914). Thomas, *Ann. Bot.* (1931); *Phil. Trans. Roy. Soc.* (1933). Rao, *Proc. Nat. Acad. Sci. Ind.* (1943) and others.
[3] Virkki, *Proc. Ind. Acad. Sci.* (1939); *Proc. Nat. Acad. Sci. Ind.* (1946).
[4] Wadia, "Geology of India", 136 (1944).

Formation of Citrate *in vivo* Induced by Fluoroacetate Poisoning

THE intensely toxic action of the rat poison sodium fluoroacetate ($CH_2F.COONa$) upon the central nervous system and heart is of special interest because of the stability of the carbon – fluorine link. Bartlett and Barron[1] have suggested that it competes with acetate ion in intermediary metabolism, and Saunders[2] and colleagues that larger chain compounds of this type must be convertible to $CH_2F.CO$ to show toxicity. Recently Liébecq and Peters[3,4], using centrifuged guinea pig kidney homogenates, have found that the oxidation of citrate formed from fumarate is inhibited by fluoroacetate. They have proposed the further hypothesis that this poison is metabolized like acetate and enters the tricarboxylic cycle, eventually 'jamming' this and causing accumulation of citrate.

We have now obtained further evidence for this hypothesis *in vivo*; rats injected with sodium fluoroacetate show relatively large accumulations of citrate in heart, kidney and brain tissue.

	Citric acid (γ)/gm. fresh tissue	
	Normal	Poisoned
	(10)	(7)
Heart	0–58	558–810
	(8)	(8)
Kidney	0–48	854–1220
	(7)	(7)
Brain	0–46	118–271

Figures in brackets indicate the number of animals tested. Dose Na–FAc = 5 mgm./kgm. body-weight intraperitoneally; animals killed 1 hour after the injection. The method of Pucher *et al.*[5] was used for citrate estimation, after boiling with acid; 'alkali heating' did not destroy the substance estimated (see Breusch and Tulus[6]).

This is interesting support both for the hypothesis proposed and also for the existence of a tricarboxylic acid cycle as a metabolic path *in vivo*.

We are grateful to Dr. B. C. Saunders for the fluoroacetate used.

P. BUFFA
R. A. PETERS

Department of Biochemistry,
Oxford.
March 10.

[1] Bartlett, G. R., and Barron, E. S. G., *J. Biol. Chem.*, **170**, 67 (1947).
[2] Saunders, B. C., *Nature*, **160**, 179 (1947).
[3] Liébecq, C., and Peters, R. A., *Proc. Physiol. Soc.* (June 1948).
[4] Liébecq, C., and Peters, R. A., *Biochim. et Biophys. Acta*, **3**, 215 (1949).
[5] Pucher, G. W., *et al.*, *J. Biol. Chem.*, **113**, 235 (1936).
[6] Breusch, F. L., and Tulus, R., *Biochim. et Biophys. Acta*, **1**, 77 (1947).

Influence of Aneurin and Aneurin Pyrophosphate on Anaerobic Pyruvate Metabolism of Pig Heart Muscle *in vitro*

IN the course of investigations on the anaerobic metabolism of pyruvate by minced pig heart muscle, we made some observations on effects of aneurin and aneurin pyrophosphate, which we think worth recording in this preliminary note. We will discuss only the influence of both compounds on carbon dioxide production, and postpone the description of effects observed on the formation of other metabolic products such as lactic acid, acetoin, etc.

The carbon dioxide production of Latapie-mince of the muscle of the left ventricle, suspended in phosphate buffer, *p*H 6·2, containing manganese ions, was measured in the Warburg apparatus at 38° C. Each vessel contained 330 mgm. of tissue; 2 mgm. sodium pyruvate was tipped in from the side-bulb. The mince was examined when fresh and also after having been stored during varying times at + 1° C.

Without added pyruvate, the carbon dioxide production was of the order of 10 mm.[3] in three or four hours; it was not influenced by adding aneurin pyrophosphate or aneurin.

The accompanying tables show the results of a few representative examples of the numerous experiments, which gave similar results without exception. The accuracy of all our measurements is similar to that shown in Table 2, in which duplicates and triplicates have been recorded.

Table 1

Heart	Condition of tissue	mm.³ CO_2 in 180 min.		% increase of CO_2 prod.
		no APP* added	5γ APP added	
A	fresh	170	186	10
	stored 24 hr.	157	200	28
	stored 48 hr.	110	151	40
B	fresh	208	214	3
	stored 48 hr.	143	192	40

* APP = aneurin pyrophosphate.

Table 1 demonstrates the effect of aneurin pyrophosphate. With fresh mince the effect is very small. It increases with increasing time of storage of the mince at + 1° C. Obviously during storage the aneurin pyrophosphate is split off from one or more enzymes associated with carbon dioxide production in anaerobiosis. The enzyme(s) can be formed again from added aneurin pyrophosphate and the bearer(s) still present. The liberated aneurin pyrophosphate will have been decomposed by the tissue phosphatase. We were able to establish that the aneurin pyrophosphate content of the tissue diminished during storage at + 1° C. We believe the most important result of these experiments is the method it indicates for reversibly removing part of the aneurin pyrophosphate from some bearer(s) in the tissue.

Storage at other values of *p*H or temperature gave much less satisfactory results.

Table 2

		mm.³ CO_2 in 240 min.			
		Heart *C* (fresh)		Heart *D* (fresh)	
I	no aneurin no APP	205, 211	*208*	188, 198	*193*
II	6γ aneurin no APP	202, 205	*203*	194, 192, 193	*193*
III	no aneurin 5γ APP	214, 215, 217	*215*	209, 206, 205	*207*
IV	6γ aneurin 5γ APP	236, 240, 241	*239*	222, 221, 217	*220*
% increase (IV–III)			*11*		*7*

Table 2 concerns the effect of aneurin. This is only seen with fresh mince in the presence of added aneurin pyrophosphate. The aneurin cannot be replaced by equivalent or greater amounts of aneurin pyrophosphate. Possibly this effect indicates the formation of some unknown prosthetic group, which might be a dinucleotide, consisting of aneurin pyrophosphate and aneurin. It is not possible to ascribe the effect of aneurin to the formation of aneurin pyrophosphate by fresh tissue particles, which are impermeable to the pyrophosphate, as simultaneous addition of the pyrophosphate is necessary in order to detect any aneurin effect. Nor can it be explained by inhibition by aneurin of phosphatase action on aneurin pyrophosphate. This inhibition has provided the explanation of the activation by aneurin of carbon dioxide production by alkaline-washed yeast, magnesium ions and aneurin pyrophosphate[1]; but according to Westenbrink *et al.*[2], rat tissue phosphatases are not inhibited by aneurin, even in very large amounts. We were able to confirm these results for pig heart muscle.

Table 3

Heart	Condition of tissue	mm.³ CO_2 in 180 min.				
		no APP no aneurin	no APP 1000γ aneurin	5γ APP no aneurin	5γ APP 6γ aneurin	5γ APP 1000γ aneurin
E	fresh	164		180	194	180
E	stored 48 hr.	153	132			
F	fresh	161	147	163	183	166
G	stored 72 hr.			201		187
H	72 hr.	92	73			
I	120 hr.	156	126	194		179

Table 3 shows the depressing effect of large amounts of aneurin on carbon dioxide production. This effect is observed with mince stored at + 1° C. as well as with fresh mince. We believe this effect to be due to partial replacement of aneurin pyrophosphate on its bearer(s) by aneurin. It can be reversed by larger amounts of the pyrophosphate.

This work forms part of investigations on the metabolism and physiological action of aneurin being carried out by Prof. H. G. K. Westenbrink and collaborators. Full details will be published elsewhere.

F. G. D. Meijer
M. Gruber
C. H. Monfoort
Laboratorium voor Physiologische Chemie
der Rijksuniversiteit, Utrecht.
Dec. 14.

[1] Westenbrink, H. G. K., van Dorp, D. A., Gruber, M., and Veldman, H., *Enzymologia*, **9**, 73 (1940).
[2] Westenbrink, H. G. K., Steyn Parvé, E. P., and Goudsmit, J., *Enzymologia*, **11**, 26 (1943).

Piezo-electric Coefficients of Ethylene Diamine Tartrate

We have determined the elastic and piezo-electric coefficients of anhydrous ethylene diamine tartrate by measurements of the resonances of bars, and of square plates, cut at various orientations to the axes of the crystals. To find the piezo-electric coefficients, we have measured the capacitance of each specimen over a range of frequencies differing from the resonance frequency by ½–3 per cent. Although all the coefficients can be deduced from eighteen specimens[1], we have used more than fifty different specimens so as to confirm our results fully.

Our values for the elastic coefficients agree substantially with Mason's[2]; but some of our values for the piezo-electric coefficients differ greatly from his. The following table includes also some results obtained by Jaffe by a statical method[3].

Piezo-electric coefficients × 10^2, C.G.S. E.S.U.

	Mason	Jaffe	New measurements
d_{14}	23·5		− 31·1 ± 0·8
d_{16}	37		− 36·5
d_{21}	34	33·9 ± 3	30·6 ± 0·5
d_{25}	− 20	5·4 ± 1·5	6·6
d_{23}	31	− 36·9 ± 3	− 33·8 ± 0·4
d_{36}	14	− 55·2 ± 6	− 54·3 ± 0·8
d_{31}	37·5		− 51
d_{34}	50		− 56·9 ± 1·8

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R. Bechmann
A. C. Lynch

P.O. Research Station,
Dollis Hill, London, N.W.2.
Dec. 30.

[1] Mason, W. P., *Phys. Rev.*, **70**, 705 (1946).
[2] Mason, W. P., *Proc. Inst. Rad. Eng.*, **35**, 1005 (1947).
[3] Jaffe, H., *Phys. Rev.*, **73**, 1467 (1948).

Interferometric Determination of the Apparent Thickness of Thin Metallic Films

Khamsavi and Donaldson[1] have described an interferometric method for the measurement of the apparent thicknesses of thin metallic films (200–700 A. in thickness). The method described was essentially that due to Wiener[2], modified to bring in the advantages of the sharp interference fringes obtained when multiple-beam interferometry is used[3]. An opaque reflecting layer is deposited over the edge of the film to be measured, and the step in this layer is measured by using it as one surface of an interferometer, and viewing this in reflexion using either fringes of equal thickness or fringes of equal chromatic order. By combining these thickness measurements with colorimetric determinations of the mass deposited upon a given area, they showed that the density of the film appeared to remain constant and equal to that of the bulk metal (silver) down to quite small thicknesses (122 A.).

As they themselves pointed out, however, this may be argued to be a necessary result, since the films used probably have small-scale discontinuities in their structure[4], and the deposition of an opaque reflecting layer over the film to be measured serves to fill up the interstices in that film until its structure resembles that of the opaque film, and hence its density appears to be that of the bulk metal. Some experiments described here tend to confirm this view.

In these experiments a thin film of silver, A_1 (Fig. 1), was laid down on to a substrate either of silver (previously deposited by evaporation to a thickness of about 1000 A.), or of glass, and over the edge of this, two opaque layers B_1 and B_2 were deposited side by side, one of silver and one of some other metal. If the 'packing-in' effect suggested above takes place, it might be expected that the steps in B_1 and B_2 would not be of the same height. This has, indeed, been found to be the case. Four typical measurements with the layer B_2 consisting of chromium, given in the accompanying table, show the magnitude of this effect.

Typical sets of multiple-beam interference fringes of equal thickness running over the steps in B_1 and B_2 are shown in Fig. 2. Owing to the relatively low reflectivity of the chromium layers, the fringes obtained over B_2 are very broad, and the accuracy of the measurements throughout is not greater than ± 25 A.

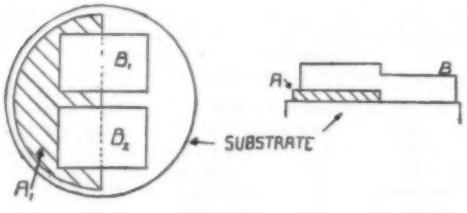
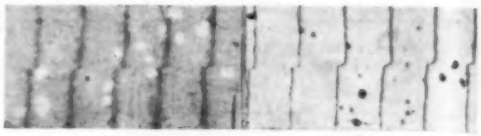


Fig. 1

Substrate	Step in B_1	Step in B_2	b	$\frac{b}{b_1} \times 100$
Silver	247	312	65	26
Silver	470	569	99	21
Glass	202	279	77	38
Glass	377	504	127	34


a *b*
Fig. 2. Fringes with (*a*) chromium; (*b*) silver

These results show that measurements of the thinner film thicknesses obtained by this method should be treated with caution, since errors of the order of 30 per cent at least may occur, possibly greater. The limitations of the method should therefore be recognized. It should be noted, however, that the method of Khamsavi and Donaldson, because of the constancy found for the apparent density, affords an accurate means of estimating the mass deposited per unit area in a given film, provided that the layer deposited over the edge of the film is of the same metal as the film itself.

I wish to express my thanks to Prof. S. Tolansky, under whose direction this work was carried out, and to the Department of Scientific and Industrial Research for provision of a maintenance grant.

D. G. Avery

Royal Holloway College,
Englefield Green, Surrey.
Dec. 28.

[1] Khamsavi and Donaldson, *Nature*, **159**, 228 (1947).
[2] Wiener, *Wied. Ann.*, **31**, 629 (1887).
[3] Tolansky, "Applications of Multiple Beam Interferometry" (Oxford Univ. Press, 1948).
[4] Thomson, *Proc. Phys. Soc.*, **61**, 403 (1948).

Absorption Spectra, Molecular Weights, and Visual Purple

Houston[1] has shown that, in the case of absorbing media, the number p of electrons per molecule of solute giving rise to an absorption band with a maximum at the wave-length λ_m is given by

$$p = \frac{4\pi n k_m}{s} \cdot \frac{m}{e} \cdot \frac{m_H}{e} \cdot \frac{\lambda' - \lambda_m}{\lambda_m^2}, \qquad (1)$$

where e and m are the electronic charge and mass respectively, m_H the mass of the hydrogen atom, n the refractive index of the solution at λ_m, k_m the absorption coefficient at λ_m, s the concentration in gram-molecules per c.c., and λ' the wave-length at which the absorption index is half the value k_m'. Houston calculated p for some thirty substances, and found values between 0·1 and 1 in eighteen cases; between 1 and 2·7 in four cases; and considerably less than unity in the remaining cases.

In other words, in the great majority of solutions p is about unity or less. This fact offers a new method for the estimation of the molecular weight of substances having an absorption band in the visible or ultra-violet part of the spectrum, for, if we assume $p = 1$, equation (1) becomes on rearrangement

$$M = 0{\cdot}4343 \left(\frac{e}{m}\right)\left(\frac{e}{m_H}\right)\frac{w}{v}\frac{1}{Dn} \cdot \frac{\lambda_m^2}{\lambda' - \lambda_m}, \quad (2)$$

where D is the photometric density, connected with k_m by

$$D = \log_{10} I_i/I_t = 4\pi \times 0{\cdot}4343\, k_m\, x/\lambda_m.$$

I_i and I_t are the intensities of the incident and transmitted radiations respectively, x being the thickness of the transmitting layer; v is the volume of the solution; w the mass of the solute.

Houston's calculations of p were made on substances of relatively low molecular weight. Before applying the transposed formula (2) to visual purple, it is advisable to check it with a substance of known high molecular weight. Reduced hæmoglobin is suitable for this purpose, because it has a single absorption band in the visible part of the spectrum; thus the effect of other bands in the ultra-violet and, possibly, near infra-red, can be neglected. The values[2] $\lambda_m = 5550$ A., $\lambda' = 5850$ A., $w/v = 0{\cdot}01$ gm./c.c., $n = 1{\cdot}33$, $D = 8{\cdot}1$, $x = 1$ cm., $e/m = 1{\cdot}76 \times 10^7$ E.M.U., $e/m_H = 9{\cdot}57 \times 10^3$ E.M.U., and $p = 1$ yield $M = 69{,}500$. This excellent agreement with the figure 68,000 obtained by other methods gives confidence both in the applicability of the expression (2) to the determination of molecular weights of this order of magnitude and also in the assumption that p, the number of electrons per molecule responsible for the mechanism of absorption, is approximately unity. It should be stressed that M is proportional to p; that is, if p is assumed to be $\frac{1}{2}$, the value of M as derived from (2) will also be halved.

Considerable interest centres around the other chromoprotein mentioned above, namely, visual purple. Found in the retinal rods of nearly all vertebrates and a number of invertebrates, this substance is intimately concerned with the physico-physiological mechanism of scotopic or twilight vision. It has an absorption maximum at 5020 A. in the visible and another in the ultra-violet part of the spectrum. As in the case of hæmoglobin, this results in a slight asymmetry, and λ' is, therefore, chosen on the long-wave-length side of λ_m also in this case. In this manner the possible contribution from the 'ultra-violet' chromophore to the extinction is reduced to a minimum. The molecular weight of visual purple was calculated from the best set of data given by Broda, Goodeve and Lythgoe[3]: $\lambda_m = 5020$ A., $\lambda' = 5480$ A., $w/v = 2{\cdot}53 \times 10^{-3}$ gm./c.c., $n = 1{\cdot}33$, $D = 1{\cdot}67$. The molecular weight of visual purple derived in this manner is 45,600. This is to be compared with the value of 270,000 obtained by Hecht and Pickels[4] using the ultra-centrifuge. In this latter determination considerable difficulty was encountered owing to the formation of micelles of high 'molecular weight' by the stromalytic and dispersing agent employed in preparing the visual purple solutions.

Using Hecht and Pickels's value for the molecular weight of visual purple, Broda, Goodeve and Lythgoe[3] calculated that the number of chromophores associated with the protein carrier was ten, assuming that the carrier weight R—the molecular weight per chromophore—was 26,500. This calculation also presupposed that the quantum efficiency of the photochemical reaction taking place on exposing visual purple to light is unity[5].

If the new value for the molecular weight, $M = 45{,}600$, be accepted, the number of chromophores associated with the protein carrier is calculated to be 1·7. There is reason to believe that the above value for M may be somewhat low; Broda, Goodeve and Lythgoe point out that their value for R should, in effect, be slightly lower: on the above basis it can thus be assumed that there are two chromophores in each molecule of visual purple.

Broda and Goodeve[6] determined the absorption spectrum of visual purple at a low temperature (− 73° C.). At this temperature λ_m moves from 5050 to 5150 A., and the curve becomes narrower, λ' being at 5340 A. Although the concentration of the solution is not given, these authors established the identity at room temperature between the absorption spectra of visual purple dissolved in water and in a 3 : 1 mixture of glycerol and water. Moreover, they demonstrated the reversibility of the changes in the absorption spectrum as effected by the change in temperature.

It seems, therefore, justifiable to calculate the ratio of the molecular weight at room temperature to that at − 73° C., and this is found to be $M_R/M_{-73°\,C.} = 0{\cdot}422$.

Considering the approximate nature of these calculations and the empirical bases on which they partly rest, a discussion of the significance of this apparent dimerization is unlikely to prove fruitful at present.

I would like to thank Dr. H. J. A. Dartnall of this Unit for valuable discussions, and Dr. J. G. Wootton, British Postgraduate School of Medicine, London, W.12, for kindly supplying me with his data on hæmoglobin.

ROBERT WEALE

Vision Research Unit,
Institute of Ophthalmology,
(University of London),
Judd Street, London, W.C.1.
Jan. 24.

[1] Houston, *Proc. Roy. Soc.*, A, **82**, 606 (1909).
[2] Wootton (private communication).
[3] Broda, Goodeve and Lythgoe, *J. Physiol.*, **98**, 397 (1940).
[4] Hecht and Pickels, *Proc. U.S. Nat. Acad. Sci.*, **24**, 172 (1938).
[5] Dartnall, Goodeve and Lythgoe, *Proc. Roy. Soc.*, A, **156**, 158 (1936); **164**, 216 (1938).
[6] Broda and Goodeve, *Proc. Roy. Soc.*, A, **179**, 151 (1941).

Knock in Internal Combustion Engines

THE information given in the two letters[1] on the above subject by D. Downs and A. D. Walsh confirm and considerably extend, with improved equipment and procedure, the observations and conclusions to which the authors refer in the paper by Egerton, Smith and Ubbelohde[2]. In that work it was found that nitrogen peroxide appeared to promote knock when the engine was run with hydrogen, and it was, indeed, suggested that the nitrogen oxides, in the circumstances, tended to sensitize the mixture. Lead tetraethyl was not found to suppress the knock. A fixed-compression Delco engine (6·75 : 1) had been used, and it now appears probable that the conditions were such as gave pre-ignition rather than true knock, and that lead tetraethyl has little effect in inhibiting the pre-ignition but prevents the knock. It would be interesting to test whether hydrogen will knock when no nitrogen or organic vapours are present (for example, using an argon atmosphere and a minimum of lubricating oil).

Our more recent experiments in a Gardner 1*L*2 compression ignition engine converted to spark ignition confirm that nitrogen peroxide has a strong pro-knock effect when added as a vapour to methane–air mixtures. The pronounced pro-knock effect of hydrogen peroxide vapour on methane was also

investigated with the same engine. Definite audible knock could be produced with a molecular concentration of 0·3 per cent of the methane. It was found that the pro-knock effect could be suppressed by lead tetraethyl. Similarly, when running on weak hydrogen–air mixtures in this engine, the knock was suppressed by lead tetraethyl, confirming, therefore, Downs's and Walsh's observations, and also that the knock induced by nitrogen peroxide in such mixtures could be similarly suppressed.

ALFRED C. EGERTON
Department of Chemical Technology,
Imperial College, London, S.W.7.
N. P. W. MOORE
Department of Mechanical Engineering,
Imperial College, London, S.W.7.

[1] Downs, D., Wheeler, R. W., and Walsh, A. D., *Nature*, **162**, 893 (1948). Downs, D., and Walsh, A. D., *Nature*, **163**, 370 (1949).
[2] *Phil. Trans. Roy. Soc.*, **4**, 33 (1935).

Dehydrochlorination and Insecticidal Action in Chlorinated Hydrocarbons

EARLY in the history of D.D.T., Martin and Wain[1] suggested that easy dehydrochlorination is necessary for insecticidal action in chlorinated hydrocarbons. This generalization has since been extended to benzene hexachloride, to chlorinated indanes and terpenes. A new group of insecticides, introduced by Julius Hyman and Co., of Denver, Colorado, provides an exception to this rule. For example, 'Compound 118', stated to be 1,2,3,4,10,10-hexachloro-1 : 4,5 : 8-diendomethano-1,4,4*a*,5,8,8*a*-hexahydronaphthalene, is stable to alcoholic potash yet is of the same order of insecticidal activity as D.D.T. Fed to caterpillars of *Mamestra brassicæ*, it was toxic at 0·14 ± 0·003 mgm. per 0·5 gm. larva, the toxic dose of D.D.T. being 0·06 ± 0·011 mgm. To adult *Calandra granaria* walking on filter paper impregnated with oil-solutions of the insecticides, the relative magnitude of the median effective doses (D.D.T. : 'Compound 118') was, after 68 hr., 4·5 : 1; after 90 hr., 2·5 : 1; after 120 hr., 1 : 1; and after 140 hr., 0·8 : 1. This difference in speed of action and differences in the reactions of the poisoned insects indicate that the two insecticides are dissimilar in their modes of action.

H. MARTIN
University of Bristol Agricultural and
Horticultural Research Station,
Long Ashton, Bristol.
R. L. WAIN
Wye College,
Near Ashford, Kent.
Dec. 14.

[1] *Nature*, **154**, 512 (1944).

Persistence of Optical Activity in an Oxidation-Reduction Reaction

TRIS-O,PHENANTHROLINE ruthenium^{II} perchlorate dihydrate[1], $Ru(phenan)_3(ClO_4)_2.2H_2O$, has been resolved through the antimonyl tartarate to give $[\alpha]_D^{20} = +979°$ and $-971°$ and $[\alpha]_{546\cdot1}^{20} = +1869°$ and $-1863°$ for the ion $Ru(phenan)_3^{++}$. Burstall[2] found $[\alpha]_{579\cdot1}^{25} = +860°$ and $-815°$ for the compound $Ru(dipy)_3I_2.2H_2O$. The orange-red active perchlorates in 6 normal sulphuric acid were oxidized with ceric nitrate to yield the optically active blue ion $Ru(phenan)_3^{+++}$, for which $[\alpha]_D^{20} = +311°$ and $-303°$ and $[\alpha]_{546\cdot1}^{20} = +1,246°$ and $-1,256°$. Reduction of the unstable oxidized ion with ferrous sulphate regenerated the ruthenium^{II} complex with its rotation unchanged. It is evident that both the di- and tri-valent ruthenium complexes have a very large abnormal rotatory dispersion.

These observations provide a unique demonstration of the essential similarity of the oxidized and reduced forms of the complexes, as well as of the simplicity of the oxidation-reduction reaction. It is of interest to note that, within an accuracy of about ± 5 mV., the optical forms and the racemate have the same redox potential.

The ferrous complex ion $Fe(phenan)_3^{++}$ was also isolated in optical forms, but the rotation was lost on oxidation due to the lower stability of the oxidized form.

Complete details will be published shortly in the *Journal of the Royal Society of New South Wales*.

F. P. DWYER
E. C. GYARFAS
Department of Chemistry,
University of Sydney.
Dec. 13.

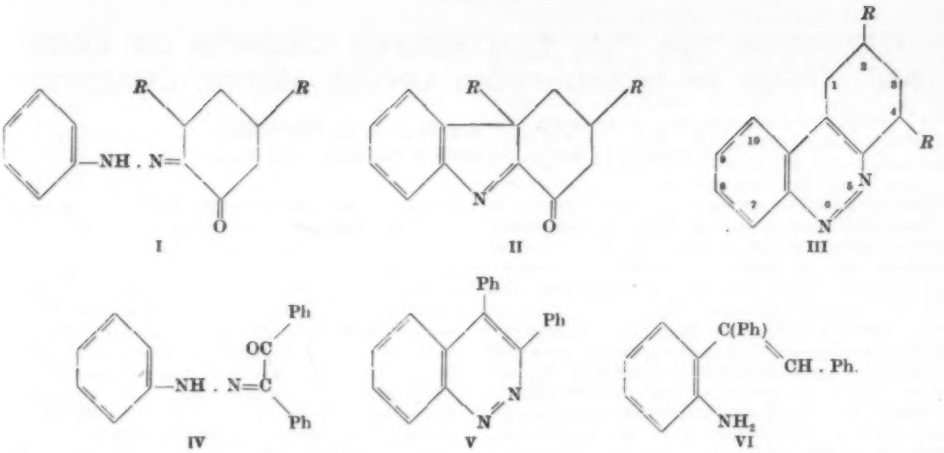
[1] Dwyer, Humpoletz and Nyholm, *J. Proc. Roy. Soc., N.S.W.*, **80**, 212 (1947).
[2] Burstall, *J. Chem. Soc.*, 172 (1936).

A New Synthesis of Cinnoline Derivatives

IN connexion with an investigation on the elaboration of the Coffey[1] synthesis of 1-ketotetrahydrocarbazoles, a study of the action of acidic reagents on a number of 1 : 2-*cyclo*hexadionemonophenylhydrazones of the type (I) has recently been undertaken. Although it has not so far proved possible to obtain 1-ketotetrahydrocarbazolenines (II) by this means, an interesting synthesis of cinnoline derivatives has come to light.

4 : 6-Dimethyl-1 : 2-*cyclo*hexadione-1-phenylhydrazone (1, R = Me) (red prisms from methyl alcohol, m.p. 58–9°; found: C, 73·1; H, 7·4; N, 11·9; $C_{14}H_{18}ON_2$ requires C, 72·9; H, 7·8; N, 12·2 per cent), which has been prepared by application of Coffey's general method (*loc. cit.*), is smoothly cyclodehydrated on dissolution in concentrated sulphuric acid to 2 : 4-dimethyl-1 : 2 : 3 : 4-tetrahydrobenzocinnoline (III, R = Me). The base (III, R = Me) (yellow needles from ligroin, m.p. 111°; found: C, 79·3; H, 7·7; N, 13·0; $C_{14}H_{16}N_2$ requires C, 79·3; H, 7·5; N, 13·2 per cent) may be isolated with ether, in 85 per cent of the theoretical yield, after addition of water and excess alkali to the reaction mixture. 1 : 2-*cyclo*-Hexadione-1-phenylhydrazone (I, R = H) may likewise be converted to 1 : 2 : 3 : 4-tetrahydrobenzocinnoline (III, R = H) (yellow prisms from ligroin, m.p. 98°; found: C, 78·1; H, 6·6; N, 15·3; $C_{12}H_{12}N_2$ requires C, 78·3; H, 6·5; N, 15·2 per cent), but the yield in this case is only 15 per cent of theory, a large amount of amphoteric material being produced simultaneously.

In order to widen, if possible, the scope of the new method, the action of sulphuric acid on benzilmonophenylhydrazone (IV) was next investigated. The use of 98 per cent sulphuric acid led to extensive decomposition; but, by employing slightly diluted acid (75–80 per cent w./w.), the non-basic 3 : 4-diphenylcinnoline (V) (yellow prisms from ether, m.p. 149–50°; found: C, 84·9; H, 5·0; calc. for $C_{20}H_{14}N_2$, C, 85·1; H, 5·0 per cent) may be obtained



in yields of 75 per cent of theory. This compound has already been described by Simpson[2], who obtained it from α(2-aminophenyl)-α : β-diphenylethylene (VI) by diazotization.

When applicable, the new method illustrated by the above examples is more convenient than those previously available.

I am indebted to Sir Robert Robinson for his interest in the investigation.

B. P. Moore

Dyson Perrins Laboratory,
Oxford.
Dec. 17.

[1] Colley, S., *Rec. trav. chim.*, **42**, 528 (1923).
[2] Simpson, J. C. E., *J. Chem. Soc.*, 447 (1943).

Influence of Solvent Movement on Sedimentation

Enoksson[1] has maintained that the major factor which causes the sedimentation constant of a protein to change with concentration is the counterflow of solvent, which is a necessary result of the sedimentation of the protein. He ascribed to the same cause the differences of sedimentation-rate in terms of which two of us[2] have accounted for the boundary anomalies observed in the sedimentation of mixtures. Pedersen[3] has repeated Enoksson's arguments.

We[2] were aware of this effect; but we consider that it can account only for a minor part of the change of sedimentation-rate with concentration, on the following grounds :

(1) The values of φ, the specific sedimentation volume, which have to be assumed are unreasonably large, and, moreover, are inconsistent with each other and with other data. For example, the value of φ obtained by Enoksson from our data[2] on the variation of the sedimentation constant of serum albumin with concentration should be 5·4 ml./gm. (Enoksson, in his Table 1, wrongly quotes a value of 10 ml./gm.); the value obtained for serum albumin from the boundary anomaly in mixtures with lactoglobulin is correctly calculated by Enoksson as about 11 ml./gm.; the maximum value consistent with the sedimentation constant of serum albumin at zero concentration ($4{\cdot}5 \times 10^{-13}$), by applying Stokes's law, is 1·5 ml./gm.

(2) The sedimentation constant should, on this theory, vary linearly with concentration down to zero concentration, whereas Pedersen[4] has shown that, in the case of lactoglobulin, the variation becomes very small at concentrations less than 1 gm./100 ml., and this finding has been confirmed recently[5]. There is no evidence that lactoglobulin dissociates under these conditions.

(3) The explanation offered does not account for the fact[2] that a protein which sediments through a solution of a less rapidly sedimenting protein (that is, the faster component of a mixture) does so at the same rate as it would do in the same total concentration of itself alone : the counterflow must be less in the former case than in the latter (cf. paragraph 1).

(4) No account is taken of the proximity of the sedimenting particles to each other ; they are treated as though each were sedimenting against the counterflow of a uniform medium of infinite extent. The effect of the proximity of neighbouring particles on their viscous movement must be an important one, though it appears that no satisfactory quantitative treatment can be given at the present time.

Enoksson further maintained that the counterflow effect can account for apparent deficiencies of the amount of a sedimenting protein, as computed from the sedimentation diagram. No deficiency is, in fact, found, provided that the solvent which is displaced is in Donnan equilibrium (which will normally be the case) and that the value used for the specific refractive increment of the protein is obtained by measurement against dialysate. Any deficiency is likely to be due to use of a wrong value for the specific refractive increment and to errors affecting the baseline of the sedimentation diagram[6].

Finally, we should point out that our account[2] of the boundary anomaly is independent of any particular assumption about the cause of variation of sedimentation-rate with concentration.

R. Cecil
J. P. Johnston
A. G. Ogston

Department of Biochemistry,
Oxford.
Dec. 16.

[1] *Nature*, **161**, 934 (1948).
[2] Johnston, J. P., and Ogston, A. G., *Trans. Farad. Soc.*, **42**, 789 (1946).
[3] Pedersen, K. O., "Ann. Rev. Biochem." (1948).
[4] Pedersen, K. O., *Biochem. J.*, **30**, 961 (1936).
[5] Cecil, R., and Ogston, A. G., *Biochem. J.*, **44**, 33 (1949).
[6] Cecil, R., and Ogston, A. G., *Biochem. J.*, **43**, 592 (1948).

A TECHNIQUE FOR THE CONTROLLED GROWTH OF EXCISED PLANT TISSUE IN LIQUID MEDIA UNDER ASEPTIC CONDITIONS

By Dr. S. M. CAPLIN* and Prof. F. C. STEWARD
Department of Botany, University of Rochester, New York

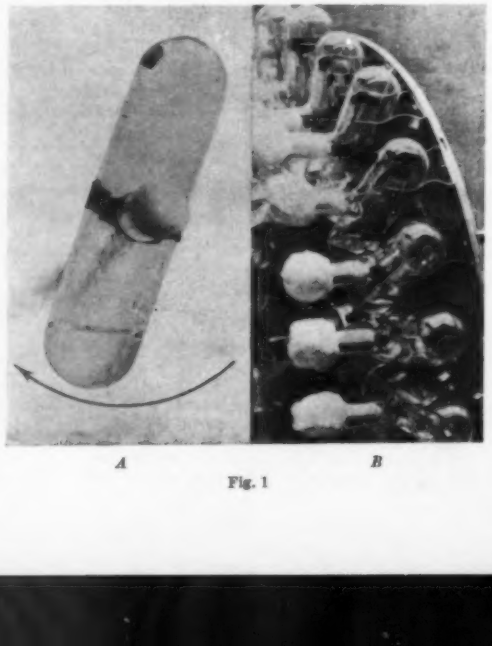
EXCISED plant tissues are commonly grown on semi-solid rather than liquid media. Immersion of the cultures in liquid media usually reduces the rate of growth (a result presumably of reduced oxygen supply), while an effect on the ability of a culture to organise has been reported[1]. Given an inherent capacity of a tissue to grow, it is apparent that the growth-rate on an agar medium may well be limited by the rate of diffusion of nutrients through the agar. Hence the growth of such cultures may be more rapid on a liquid medium which is continually mixed, provided that access to oxygen is adequate. Growth in liquid media has obvious advantages wherever quantitative experiments on the absorption or nutritive effect of specific solutes is in question. It will be shown that for certain types of culture the liquid medium produces greater and more uniform growth.

DeRopp[2] has described an apparatus using liquid media for growth of excised plant tissues. In this technique the cultures were to be alternately bathed in the nutrient medium, then drained and exposed to air; but no growth-data from the use of this apparatus have been reported. Moreover, the technique appears rather unwieldy and hence is adaptable only to a relatively small number of cultures.

In the University of Rochester other methods have been devised. The method reported here has been found to be most satisfactory and instructive for the growth of excised plant tissue cultures, and is now described because it may be useful to other workers and may find further application in other biological fields.

In brief, the method makes use of a new type of culture tube: the tubes are mounted on disks which are slowly revolved about a horizontal shaft so that each tube is tumbled end over end.

The culture tube (Fig. 1*A*) is made from 'Pyrex' glass tubing sealed and rounded at each end. At the middle of each tube is a side neck through which the transfer of cultures can be made and, when plugged with cotton, through which gas exchange can occur. The culture tubes are mounted near the periphery of a circular disk of plywood so that the long axis of each tube lies along a radius of the disk and the side neck is parallel to the shaft (Fig. 1*B*). Twenty-four tubes (35 mm. in diameter and 125 mm. long) can be fastened to each disk, and many disks may in turn be fastened to a single shaft: for example, eight disks, accommodating 192 tubes, can be mounted on a shaft 40 in. long. The shaft is driven by a motor and is geared to 1 r.p.m. In this Department the entire shaft is mounted in a cabinet in which constant temperature, humidity and light may be maintained. The revolving klinostat equalizes gravitational stimuli and ensures that all the cultures are subjected to the same environmental conditions.



A *B*

Fig. 1

As a tube 'tumbles' on the rotating klinostat the wet piece of tissue adheres at one end of the tube (Fig. 1*A*), whereas the liquid moves slowly from one end of the tube to the other, and as it does so, gaseous exchange with the outside air is maintained. It will readily be appreciated that with a constant volume of nutrient the fraction of the total time in which the tissue is immersed varies with the proportions of the tube; also with a tube of fixed dimensions the period in air decreases as the volume of nutrient is increased. For any given tube an upper limit to the volume of solution is set when the liquid, flowing along the now horizontal tube, tends to wet the plug. Somewhat larger volumes may be used if the axis of the klinostat is inclined to the horizontal. With these factors in mind, the dimensions of the tube have been fixed as indicated above. Ten ml. of a nutrient medium in a tube is convenient when maximal time in air is desired and also when such factors as the length of growing period for which nutrient must be furnished are taken into account.

In a previous note[3] it was shown that uniform 4-mgm. cylinders cut from carrot root will grow at rates far exceeding those previously described if coconut milk is added to the nutrient agar medium. In the present experiments carrot cultures were grown both in test tubes on agar and in liquid medium on the revolving klinostat described. All the cultures were exposed to the same external conditions and were exposed to the continuous light of a bank of fluorescent lamps. The cultures in the klinostat tubes were grown on a basal nutrient medium[4] to which was added 15 per cent by volume of coconut milk. For the cultures grown in test-tubes 0·8 per cent agar was added to the nutrient medium. All the explants were obtained from carrot cylinders, removed by a cannula, and cut with a multi-bladed cutter into 4-mgm. radial cylinders. Only phlœm cylinders with their inner tangential surface 1 mm. from the cambium were used. This technique and its implications will be described elsewhere.

* Postdoctoral Research Fellow, National Institute of Health, Washington, D.C.

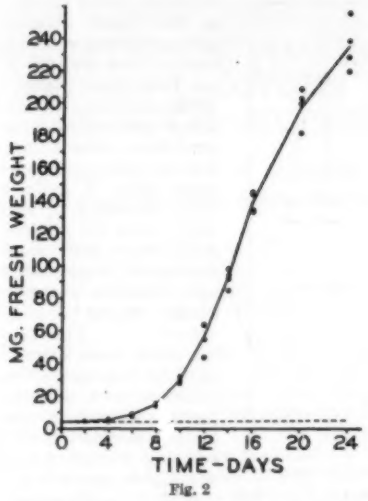


Fig. 2

In a given experiment, cultures grown in the klinostat tubes were not only larger and more uniform but also, under the standardized conditions of the klinostat, the growth-rates of carrot cultures are much more reproducible than when the cultures are grown in nutrient agar in the test tubes.

Fig. 2 shows a growth-curve of cultures of carrot initially 4 mgm. in weight. At each period four replicate cultures were weighed, and the curve is compiled from their means. There is evidently a lag of about four days followed by a very rapid growth reaching a compound-interest rate of increase in twelve days of 34·1 per cent per day. After some days a gradual decrease in the growth-rate occurs. This decrease is probably due in part to depletion of nutrients in the culture medium. (Changing the culture solution after some fourteen days does increase the growth.)

Single cultures readily grow from a 4-mgm. explant to about 175 mgm. before they become so large that they do not readily adhere to the glass, and so fall as the tube rotates. The amount of tissue grown in a given tube and medium may be increased by using more explants per tube, but this markedly reduces the size of each cultured explant. For the most part, the technique has been applied to cultures freshly excised from the carrot root. The rates of growth of subcultures tend to be more variable, probably because they cannot readily be cut into pieces of uniform size and shape which contain identical proportions of active cells.

Cultures grown in liquid media in klinostat tubes and on agar differ in form: the former become compact spheroids, especially when grown in the light, while those on agar become much more succulent and irregularly concave to the medium. In the dark, cultures in klinostat tubes become friable and tend to fall apart. These differences are being investigated and will be reported elsewhere. In the dark, carrot phloem cultures change from deep orange to pale. In the light they become pale green. Cultures from certain carrots in the light have, however, been observed to become unpredictably coloured with a red pigment in the surface layers of cells. This does not, however, affect the conclusions on the efficacy of the technique here described.

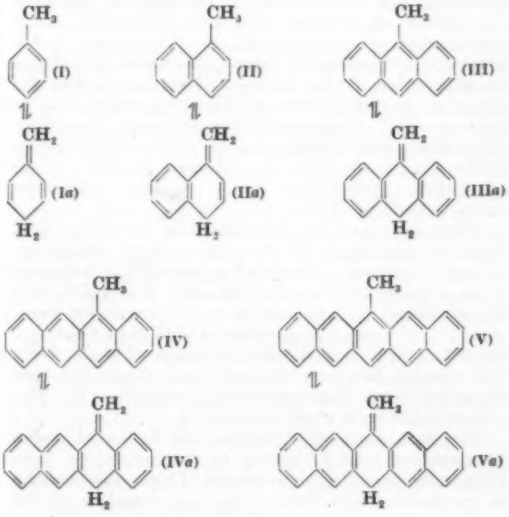
Clearly this technique is applicable to the growth of other materials in liquid media. The growth of *Chlorella vulgaris* in the klinostat tubes was found to compare very favourably with growth under other conditions in liquid media as used by other workers. Ten ml. of the basal culture solution, in equilibrium with the carbon dioxide of the air, inoculated to contain 75 cells per mm.^{3}, produced in 7 days at 25° C. 57,000 cells per mm.^{3} at a light intensity of 240 foot-candles. The technique may well find application in the experimental growth of fungi for antibiotic studies, growth studies of yeast, etc. It has, however, proved its use in quantitative investigations on the growth of plant tissue cultures.

[1] White, P. R., *Bull. Torrey Bot. Club.*, **66**, 507 (1939).
[2] DeRopp, R. S., *Science*, **104**, 371 (1946).
[3] Caplin, S. M., and Steward, F. C., *Science*, **108**, 655 (Dec. 1948).
[4] White, P. R., "A Handbook of Plant Tissue Culture" (Jaques Cattell Press, Lancaster, Pa.).

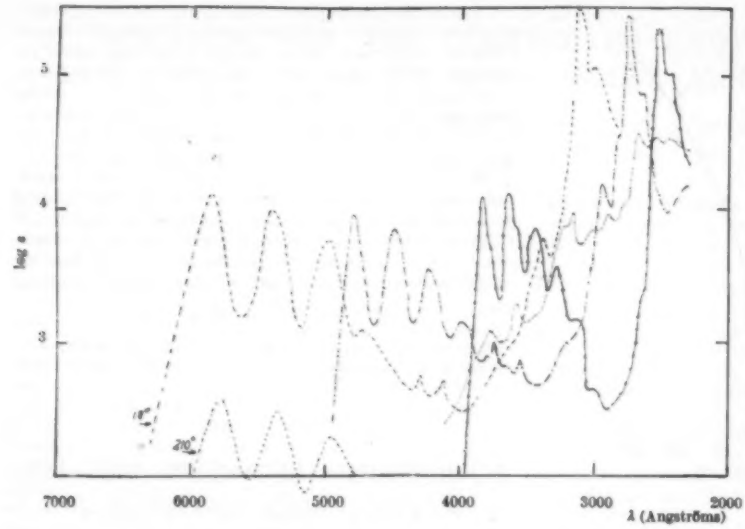
EQUILIBRIUM BETWEEN METHYL-ACENES AND METHYLENE-DIHYDROACENES

By Dr. E. CLAR* and J. W. WRIGHT
Chemistry Department, University of Glasgow

TAUTOMERISM between methyl-acenes (I, II, III, IV, V) and methylene-dihydroacenes (I*a*, II*a*, III*a*, IV*a*, V*a*, respectively) has often been postulated to explain side-chain reactivity of aromatic compounds, but hitherto no methylene-dihydroacene has been isolated. This weakness in the hypothesis has now been removed by the synthesis of pure 6-methylene-6 : 13-dihydropentacene (V*a*). The 'anellation principle'[1] requires a gradual transition in properties in the acene series, and it may be inferred, therefore, that (IV), (III), (II) and (I) will also contain the corresponding methylene forms, but in decreasing proportions.



* I.C.I. Research Fellow.



Absorption spectrum of 9-methylanthracene in alcohol. Band maxima at: 3850, 3640, 3460, 3290, 3140, 3000; 2540, 2460 A.

Absorption spectrum of 5-methyltetracene in alcohol. Band maxima at: 4805, 4490, 4220, 3980; 3750, 3560; 2950, 2755, 2650 A.

Calculated absorption spectrum of 6-methylpentacene in 1-methylnaphthalene. Band maxima at: 5850, 5410, 5010; 4300, 4120; 3390, 3150 A.

(Lower curve.) Observed absorption of methylpentacene at 210° in 1-methylnaphthalene: 5790, 5360, 4960 A. (intensity qualitative); on rapid cooling the fading band maxima shift to: 5850, 5410, 5010 A.

Absorption spectrum of 6-methylene-6:13-dihydropentacene (*Va*) in alcohol. Band maxima: 3770, 3585, 3420; 3175, 3020, 2900; 2690, 2570 A.

This view is supported by study of the absorption spectra of the hydrocarbons (see accompanying graph). The spectrum of 9-methylanthracene (III) resembles very closely that of anthracene, but does not exclude the presence of a small proportion of the methylene form (III*a*), which would have only feeble absorption. The orange 5-methyltetracene (IV) shows an absorption similar to that of tetracene, but the intensity of the bands is considerably lower than in the case of tetracene, whereas with 9-methylanthracene and anthracene the reverse relationship holds. This suggests the presence in (IV) of an appreciable proportion of a weakly absorbing methylene form (IV*a*).

When we come to the pentacene series, we find that the spectrum of the pale yellow methylene-dihydropentacene (*Va*) shows no resemblance to that to be expected for methylpentacene (V), which may be calculated by application of the anellation principle[1]. If the pale yellow solution of (*Va*) in 1-methylnaphthalene is heated with exclusion of air to 200°, the solution becomes violet-red and shows the first three bands calculated for methylpentacene (V). The colour fades slowly on cooling.

The fact that methylpentacene exists at room temperature almost entirely in the methylene form (*Va*) is important from the point of view of resonance in aromatic compounds. As each member of the pairs of structures formulated above contains the same number of double bonds as the other member, the energy-difference between the methyl form and the methylene form must consist of the difference in resonance energy. Wave mechanical treatment predicts a decreasing difference in resonance energy of these pairs of hydrocarbons with increasing numbers of rings, until the difference becomes zero with an infinite number of rings[2]. Hence the ratio between methylene and methyl forms should never exceed 1 : 1. This prediction has thus been shown to be entirely erroneous, and the evidence now adduced may perhaps provide a new basis for the calculation of the decreasing energy per ring in the higher acenes.

9-Methylanthracene (III) was prepared as described by Sieglitz and Marx[3]. 5-Methyltetracene (IV) was obtained by dehydration of the crude carbinol formed by interaction of methylmagnesium iodide with tetracenone, prepared by reduction of 5 : 12-tetracenequinone[4] with alkaline sodium hydrosulphite solution. It formed orange-red prisms (from benzene), m.p. 160°, and gave a bright green solution in sulphuric acid (found: C, 94·2; H, 5·7. $C_{19}H_{14}$ requires C, 94·2; H, 5·8 per cent).

6-Methylene-6 : 13-dihydropentacene (*Va*) was similarly prepared from pentacenone[5], and formed pale yellow needles (from xylene), which dissolved in sulphuric acid to give a blue solution which afterwards turned to brown (found: C, 94·4; H, 5·65. $C_{23}H_{16}$ requires C, 94·5; H, 5·5 per cent). The melting point was between 244° and 254°, and in an evacuated capillary the melt was deep red. Oxidation with selenium dioxide in boiling nitrobenzene gave pentacene-5 : 13-quinone. A sparingly soluble by-product from the Grignard condensation formed colourless crystals, m.p. 420° (decomp.), which gave a greenish-yellow solution in sulphuric acid (found: C, 94·2; H, 5·8. $C_{46}H_{32}$ requires C, 94·5; H, 5·5 per cent).

We thank the Department of Scientific and Industrial Research for a grant which enabled one of us (J. W. W.) to participate in the experimental section of this investigation.

[1] Clar, E., "Aromatische Kohlenwasserstoffe", 20 (Springer-Verlag, 1941).

[2] Sirkin, J. K., and Diatkina, M. E., *Bull. Acad. Sci. U.R.S.S.*, Cl. Sci. Chim., 153 (1946). Brit. Abstr., AI, 365 (1946). The view of these authors was supported, and in some cases an even greater stability of the higher methyl-acenes was predicted in private communications from other workers.

[3] *Ber.*, **56**, 1619 (1923).

[4] Clar, E., *Ber.*, **75**, 1271 (1942). Compare Fieser, L. F., *J. Amer. Chem. Soc.*, **53**, 2329 (1931).

[5] Marschalk, Ch., *Bull. Soc. Chim.*, (5), **4**, 1549 (1937).

USE OF GEIGER COUNTER FOR QUANTITATIVE ESTIMATION OF RADIOACTIVE ISOTOPES IN HISTOLOGICAL SECTIONS

By Dr. GEOFFREY H. BOURNE

Department of Histology, London Hospital Medical College

THE problem of obtaining quantitative estimation of radioactive isotopes in histological sections has been under investigation in this laboratory for the past year, and an attempt at its solution is described below.

A detachable, movable stage had soldered to its under-surface a $\frac{1}{4}$-mm. sheet of copper in which a $\frac{1}{4}$- or 1-mm. hole had been drilled. A microscope slide placed in the movable part of the stage could then be altered in position at will so that the whole of any section mounted on it could be 'scanned' by the hole. A lead 'castle' has been designed to take this movable stage and its slide. It consists of a circular shouldered base (5 in. high) which is hollow and contains a brass tube with a screw-on head in which the Geiger–Müller counting-chamber is mounted. The head has a $\frac{3}{4}$-in. diameter hole by which access is obtained to the window of the counting-chamber. On top of the shoulder fits a square lead tray with an eccentrically placed hole (4 in. diameter), through which the head of the base projects. On top of this tray fit three $1\frac{1}{2}$-in. thick blocks of lead. The movable stage is placed in the tray with the 1-mm. hole in its copper shield directly above the window of the counting-chamber. The three blocks of lead are placed above the tray to reduce cosmic and other interference.

Fig. 4

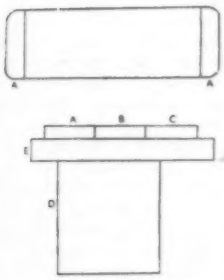
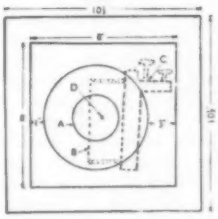


Fig. 1

Fig. 3



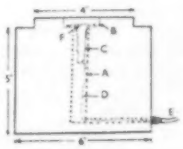


Fig. 2

Fig. 1. General elevation view of lead 'castle'. *A,B,C.* Slabs of 'lead' (see Fig. 4) covering top of castle. *D.* Base. *E.* Upper portion in which movable stage is placed

Fig. 2. Base of lead 'castle'. *A.* Brass tube. *B.* Metal cap holding Geiger–Müller counter in position. *C.* Geiger–Müller counter. *D.* Connexion from Geiger–Müller counter to exterior. *E.* Connexion from castle to power unit and scaler. *F.* Window of Geiger–Müller counter

Fig. 3. Tray for holding movable stage. *A.* Window of Geiger–Müller counter. *B.* $\frac{1}{4}$-mm. copper sheeting underlying microscope slide and attached to movable stage. *C.* Movable stage. *D.* Scanning hole (varying from $\frac{1}{4}$–1 mm.) in *B*

Fig. 4. One of three lead slabs for covering Fig. 3. *A.* Lifting flaps

The advantage of this movable stage is that it can be placed under a microscope and the piece of tissue from which one wishes to count moved directly over the hole in the copper sheet. A photograph can, in fact, be taken of each field of tissue, prior to counting, if desired. Tissues used for this purpose can be cut and mounted in the usual way on glass slides; but if a glass cover slip is used, the radiation from the section is reduced by at least one-half. 'Cellophane' cover-slips are therefore preferable. A 1-mm. scanning hole is about equal to the field seen under a low-power ($\frac{2}{3}$) objective of the microscope and, of course, covers a piece of tissue of appreciable diameter. Smaller holes can be obtained by piercing $\frac{1}{4}$-mm. sheets of lead with a needle, and by this means holes equal to the size of a high-power ($\frac{1}{6}$) microscopic field can be obtained. These lead sheets can be stuck over the copper shield with cellulose acetate-tape, the smaller hole being superimposed on the 1-mm. hole in the copper. It is possible to obtain still smaller holes by this method, but it will have to be shown that the apparatus is sensitive enough to make smaller 'scanning' holes desirable.

Dalgaard[1] has also published on this subject, which he has approached in a similar but not identical fashion. He has described a method of obtaining quantitative estimates of alkaline phosphatase activity by allowing the enzyme to deposit radio-phosphorus until there is enough activity for counts to be made. It is more difficult to apply this method for estimating activity in histological sections of tissues from animals which have been injected with radioactive isotopes. A few results which give an indication of the scope of the present technique are therefore appended.

A slide bearing a 10-μ section of thyroid but with no thyroid tissue over the scanning hole, and taken from a rat which had been injected with 24 micro-curies of iodine-131 six hours before it was killed, was placed in the 'castle'. The background count was 12 per minute. The slide was then moved so that thyroid tissue was over the hole. Sections of about thirty follicles of various sizes could be seen. Ten counts of the same field varied between 26 per minute and 53 per minute, with an average of 39·8.

Pieces of thyroid from the same rat were then treated with hydrochloric acid and the follicles separated away from each other by needles under a dissecting microscope. The tissue was then covered by Apathy's mounting medium and dried. By placing this slide in the apparatus, it was possible to move the scanning hole so that it covered only a single whole follicle. The greater volume of thyroid tissue on this slide gave a higher background count of 71 per minute. Counts from four different follicles of approximately equal size were 143, 123, 153 and 134 counts per minute. It seems that with further refinement we may expect to obtain significant counts at a still lower microscopical level.

The method has also been applied to ground sections of lower jaws and femurs of rats which had been injected with radiophosphorus.

It appears that this technique would be of value for studying the distribution of radioactive isotopes in both adult and particularly embryological tissues.

I am greatly indebted to Mr. R. Oliver, of the Radiotherapy Department, London Hospital, and Mr. A. Love, of the E.R.D. Engineering Co., for most valuable assistance in the design and assembling of apparatus described herein.

[1] Dalgaard, J. B., *Nature*, **162**, 811 (1948).

SPECTROPHOTOMETRIC EQUIPMENT

THE forty-fifth science meeting of the Colour Group of the Physical Society was held on March 30 at the Royal Photographic Society, 16 Prince's Gate, South Kensington, S.W.7, to discuss "Photo-electric Spectrophotometers and Tricolorimeters". The meeting was arranged to explain the difficulties that may be encountered by those contemplating work with these instruments, and to compare the different methods of measurement. Dr. W. S. Stiles was in the chair, and about ninety people were present.

The discussion was opened by Dr. T. Vickerstaff (Imperial Chemical Industries, Ltd.), who had recently been in the United States, and who described American instruments. He said that most research associations there seemed to possess a Hardy recording spectrophotometer and that each owner appears to have done something to improve it. Improvements included those to lengthen the life of the lamp, to overcome difficulties due to polarized light, to reduce scattered light, to improve the efficiency of the sphere-photo-electric cell unit, and to facilitate fitting the paper accurately on the drum. A new design is being made in which a linear wave-length scale is provided both for the visible and near infra-red ranges.

Another widely used and generally approved instrument is the Cary recording spectrophotometer, with an operational wave-length range from 0·21 μ to 0·6 μ and marked ranges from 0·2 μ to 0·35 μ and 0·3 μ to 0·8 μ. The slit widths at which this instrument operates are exceedingly small, about 0 0002 μ. This is a welcomed improvement on the Hardy instrument, in which the sum of the slit widths is 0·02 μ. The Snow-Duplex cathode ray spectrophotometer was seen, but an opinion on its performance was not possible owing to the conditions prevailing at the time. The non-recording Beckman is widely used, and a cheaper model with a direct-reading meter is being marketed.

Three calculators to give C.I.E. chromaticity co-ordinates from the spectral transmission curves were seen. One at the General Aniline Company was coupled directly to the Hardy spectrophotometer and evaluated the summations during the recording. An accuracy of 0·0005 was claimed.

The photo-electric tricolorimeters seen were the Hunter reflectometer and the P.P.G.I.D.L. colour eye. Both these instruments used photo-electric cells with filters to obtain the required C.I.E. distribution curve sensitivity.

General requirements for spectrophotometry were indicated by Mr. H. G. W. Harding (National Physical Laboratory). He said that direct-current light sources are desirable so that sectors can be used. Double monochromators are necessary, and the wave-length control should focus the optical system and alter the slit widths so that a fixed wave-band can be chosen throughout the spectrum. Some of the slits should be curved, and the exit slit should be straight for thermopile work. Some routine measurements require detectors to measure energy ratios of 10^4 to 1, and although it is preferable that the photo-electric cells should act only as out-of-balance detectors, the linearity of their response has to be relied on for such measurements. Reflexion measurements for colorimetry should be made under C.I.E. conditions, and annular cathode photo-electric cells would facilitate this. Completed instruments should be tested separately for wave-length calibration by line sources, and for linearity by neutral glass filters. Automatic instruments that would deal with large specimens are desirable; those now available are very valuable, but they are not as accurate as manually operated instruments, neither will they measure very low transmissions.

Dr. A. Sommer (E.M.I. Research Laboratories) explained how different parts of the spectrum range between 0·2 μ and 1·3 μ can be detected by antimony-cæsium cathodes in quartz or glass envelopes, bismuth–silver–cæsium cathodes and silver–oxygen–cæsium cathodes. Gas-filled cells are unsuitable for precision measurements, he said, and the vacuum types are generally used. Multiplier cells are useful for very low illuminations and for light signals of high frequency. Antimony–cæsium multiplier cells are made with multiplication factors of the order of 10^8. Two types of antimony–cæsium multiplier cell are made in Great Britain, one in which the light passes through the bulb to the cathode on the opposite side (thick-layer type), and another in which the semi-transparent photocathode is deposited directly on the inside of a flat entrance window. The latter type has an improved red sensitivity and reduced blue sensitivity compared with the former, and it has the advantage that a luminous surface can be held within a few millimetres of the cathode. Quartz windows are to be fitted to these cells.

Particular needs for spectrophotometry were outlined by Mr. J. R. Stansfield (Hilger and Watts, Ltd.). He said that hydrogen lamps with a current stability of 1 part in 20,000 give a radiation output constant to better than 0·05 per cent, and tungsten filament lamps can give similar stability, although greater care is necessary in controlling the power supplies. The variations in Nernst filaments and glow-bars for infra-red radiation make double-beam spectrophotometry desirable.

The elimination of stray light should receive particular attention, and although double monochromators are necessary for some work, single monochromators are adequate for many purposes, as some can give a stray light intensity of less than 0·1 per cent of the pure radiation intensity. Double-beam spectrophotometry eliminates errors due to fluctuations in the source of radiation; but as exact equality of two monochromators is difficult to obtain, the practice of passing the two beams alternately through one monochromator is now being adopted. The photo-electric cells of the detectors should, where possible, be used only as indicators of inequalities between successive beams of light. More multiplier cells should be made available, especially ultra-violet sensitive ones, and there is a need for accurate high-speed recorders.

Mr. G. T. Winch (General Electric Co., Ltd.) was unfortunately not able to address the meeting. His contribution was read by Mr. R. G. Horner, and Miss B. M. Young answered questions about it. A description was given of the dispersion and mask method, in which a spectrum is formed and a mask used in the plane of the spectrum to limit the transmission of light of each wave-length. The method is theoretically perfect; but many precautions are necessary if the accuracy of visual methods, namely, 0·01–0·02 in the chromaticity co-ordinates for a 2°-field, or 0·001–0·004 for a 15°-field, are to be obtained without resource to substitution methods. The requirements have been met by temperature

control of the photo-electric cell, which is linear to a few parts in 10,000 for a 10 to 1 light ratio, having grid leak values up to 10^{13} ohms in a D.C. amplifier giving a limiting sensitivity of about 10^{-11} lumen to get adequate sensitivity, obtaining a spectral resolution of about 0·0003 μ in a 30-mm. spectrum and by producing masks by the Kodak etch-bleach process. The $\bar{x}$, $\bar{y}$, $\bar{z}$ and spectrum band masks are mounted on a wheel, and a blue temperature-conversion filter is used to compensate for the yellowing of sphere paint when it is part of the instrument.

A general discussion followed, and many aspects of spectrophotometry and colorimetry were considered. At the end of the discussion it seemed that the fully automatic recording spectrophotometers for ultra-violet and visible radiation made in the United States are giving good service, and that the photo-electric colorimeters developed in Great Britain are likely to give the same to colorimetry. It was pointed out that annular cathode photo-electric cells have been made in Britain.

The meeting was closed by a description and demonstration of the new Hilger Uvispek photo-electric spectrophotometer. This manually operated instrument, which covers the wave-length range from 0·21 μ to 1·0 μ, should be of great value in the field of spectrophotometry. H. G. W. HARDING

AUTOMATIC CONTROL-SYSTEM TERMINOLOGY

AT the request of the Ministry of Supply, the British Standards Institution is preparing a "Glossary of Terms used in Automatic Controlling and Regulating Systems". This is divided into four Sections, the second of which, on "Process Control"*, has been published recently; Section 3, which is in preparation, will cover the nomenclature of position control, and Section 4 will deal with automatic regulators; Section 1, which is to contain the terms common to all closed-loop servo systems, will be prepared when the other three have been completed. Every definition is given a four-digit reference number, indicating its section, subsection and position therein.

Section 2 is a welcome publication, representing the first serious attempt which has been made in Great Britain to bring some semblance of order into a field where chaos has reigned supreme. The existing confusion is due partly to historical accident, for the three main divisions of control engineering were developed separately by groups having little contact with each other. For example, the designers of engine-speed governors, of thermostats and of military fire-control equipment failed to appreciate in the early stages that they were all concerned fundamentally with the same problem: namely, that of increasing the accuracy of performance of their equipment, under ever more stringent conditions of load and disturbance, while maintaining an acceptable standard of stability in the system as a whole. It was due to this lack of contact that three separate systems of nomenclature are now current; not only is the same phenomenon referred to by several different names, but also, even worse, the same word is often used by different engineers to indicate quite distinct phenomena.

The aura of mystery which surrounds the whole subject of automatic control in the minds of many engineers can be attributed largely to its illogical and unscientific terminology. In fact, the situation is even more chaotic than that stated above, for there is a considerable variety of usage even among the workers in a single field; a most valuable purpose will be served by the new glossary if it does no more than standardize the practice within each of the three separate fields, and it is to be hoped, therefore, that every control engineer will adhere to the recommended usage.

The glossary could be of more fundamental importance if it also helped to introduce a greater degree of uniformity between the separate fields of control. It is difficult, with only one part now available, to judge to what extent it will do this; but the task is undoubtedly a difficult one, for the technical differences between the fields are in some respects considerable, though by no means as great as is generally believed. It is regrettable, perhaps, from this point of view that it has been found necessary to separate the glossary into sections, for this will tend to emphasize a distinction which is in many instances more apparent than real.

As an example, consider the word 'offset' (definition 2203); in position control practice this is called the 'steady state error'. Is the latter term to be scrapped, or are we to have two names for the same thing? Again, is it impossible to persuade process control engineers to use the terms 'input', 'output' and 'error', in place of 'desired value', 'controlled condition' and 'deviation'? The former sound scientific, the latter sound amateur. The sign of the deviation is defined differently from what is customary for *position* control in Great Britain and in the United States. The Americans are unlikely to alter their practice, so that this will perpetuate the present ridiculous anomaly of having two contradictory definitions in use simultaneously; for it is a sad fact that the only books on control engineering come at present from the United States.

The intention is to review the present standard in a year, and suggestions for improvement are requested. The following comments may therefore be of some value. Terms for 'input element' and 'difference element' are not defined; they might be combined to form an 'input unit'. 'Measuring unit' (2106) is defined in terms of 'measuring element', which is listed among those terms the use of which is deprecated; this emphasizes the point that it is, in fact, necessary. 'Floating control' is not mentioned as a synonym for 'integral action'; it should at least be given, if only to deprecate this common usage. 'Proportional band' (2502) has another meaning, different from that given, namely, "the range within which controller action is linearly related to deviation"; if its use in this sense is deprecated, some alternative should be provided. Finally, the term 'two-step action' (2408) is an unsatisfactory alternative to 'two-position action' (deprecated), since such a control has only one step, though it has two positions.

It would, of course, be possible to make other minor criticisms; but these do not detract from the entirely admirable intention behind this glossary and the treatment which, so far as one can judge at present, maintains the high traditions of the British Standards Institution. R. H. MACMILLAN

* British Standard No. 1523:1949. Glossary of Terms used in Automatic Controlling and Regulating Systems. Section 2: Process Control. Pp. 21. (British Standards Institution, 24/28 Victoria Street, London, S.W.1.) 2s. 6d.

GENETICS OF DIŒCY AND MONŒCY IN *ECBALLIUM*

DIŒCY, the separation of the sexes on to different diploid individuals, occurs irregularly throughout the higher plants. It must therefore have arisen a number of times during the evolution of this group. Thus the genetical control of diœcy is of considerable interest, particularly in regard to the differences between diœcious forms and their monœcious or hermaphroditic relatives. Little information has been available about such differences in the past; but two mimeographed papers[1,2] have now been circulated, in which Dr. F. Galán, of the University of Salamanca, describes the results of crosses between diœcious and monœcious forms of the cucurbitous plant *Ecballium elaterium*.

The monœcious form occurs in the northern half of Spain and the diœcious form in the southern half. The two appear to be readily crossed in both directions. The hybrids are fertile and various F_2 and back-cross progenies were raised. These indicated that monœcy is determined by a third allelomorph at the locus, the other two allelomorphs of which operate the normal sex mechanism in the diœcious form. Thus the monœcious form is (in Galán's notation) $a^+ a^+$, while in the diœcious types males and females are $a^D a^d$ and $a^d a^d$ respectively. The allelomorph a^+ seems to be recessive to a^D but dominant to a^d.

A few plants occur which are unexpected in this scheme. It seems that they are individuals which should be monœcious, carrying both types of flower; but actually bear flowers of only one sexual type. The experiments could not easily have revealed whether there occurred opposite types of aberration, genetically male or female plants bearing both sexual types of flower. No information is therefore available on this point.

About 1 per cent of the plants which presumably are genetically monœcious in Galán's scheme appear as females in the F_1. These must, however, be $a^+ a^d$, so that we may suppose the dominance of a^+ over a^d not to be unconditional. In F_2 and back-crosses, aberrant types appear which cannot be explained so simply. Thus monœcious F_1 plants, which must be $a^+ a^d$, give occasional males, as well as the monœcious and female plants expected, on selfing. We must suppose these males to be genetically $a^+ a^+$ or, less likely perhaps, $a^+ a^d$. In back-crosses, plants which must be $a^+ a^+$ sometimes appear as females. The frequencies of these aberrant phenotypes are about ½ per cent in the back-crosses and nearly 7 per cent in F_2.

The author records that a plant which appears as male or female in its first year of flowering may carry both types of flower in later years, the chance of this occurring being itself genetically controlled. The F_1 was classified as second-year plants, but the F_2 as firsts. Thus the frequencies of aberrant phenotypes in these latter generations may be somewhat overestimated. This over-estimation is, however, unlikely to be great, as only ½ per cent of the back-cross plants seem to be aberrant.

It would thus appear that in addition to their allelomorphs at the main, *a*, locus, the two forms differ in their genetic backgrounds. The diœcious form contains genes, doubtless members of a polygenic system, which, when introduced by crossing into a plant monœcious in respect of the *a* locus, upset its development so that it digresses towards one sex or the other. It is not clear whether the background genotype of the F_1 would ever cause such an upset in $a^+ a^+$ plants; but it does seem clear that, even if it did, the upset would be rarer than is observed in F_2. In other words, the F_1 is heterozygous for the differences in genetic background, and these differences segregate in F_2. Some 7 per cent of the segregant backgrounds are unbalanced in the sense that they divert the normal monœcious development. The disturbing effect of segregation should be less in back-crosses, as indeed the lower frequency of aberration shows it to be.

Thus the evolutionary divergence of the monœcious and diœcious forms seems to have followed the genetic pattern familiar to us from other mechanisms controlling the breeding system. A difference has developed at a main locus, the segregation of which operates the diœcious system. But at the same time the genetic background of each form has been adjusted, in its own special way, to give just those types which the main gene immediately determines. On this basis we can further see how populations could show a gradual transition between monœcy and diœcy through a state consisting of a mixture of the two. It is to be hoped that the author will continue his experiments and establish the genetical interpretation more firmly by further investigation of aberrant individuals and mixed populations in later generations of selected lines.

Dr. Galán has also published an extensive review[3] of the various genetical theories of sex determination in animals and plants; but this is written in Spanish.

K. MATHER

[1] "Analysis of the Genetic Differences between the Monœcia and Diœcia Zygotes in *Ecballium elaterium*."
[2] "Analyse génétique de la monœcie et de la diœcie zygotiques et leur différence dans *Ecballium elaterium* (Cucurb)."
[3] "Exposision y critica de las Teorias de la Determinacion del Sexo" (Salamanca, 1942).

SOIL CONSERVATION IN BRITISH COLONIES

THE serious nature of the problem of soil erosion in many parts of the British Colonial Empire has been realized for some time, and in recent years much has been done to extend conservation measures. Considerable experience has accumulated since the position was last reviewed in 1944; but the more recent information has remained scattered, and in 1946, with the approval of the Secretary of State for the Colonies, a questionnaire was sent to the directors of agriculture in dependencies where soil conservation had made good progress. The information received, supplemented by data from published papers and reports, has been collected together by Sir Harold A. Tempany and issued by the Commonwealth Bureau of Soil Science, Harpenden, as Technical Communication No. 45, "The Practice of Soil Conservation in the British Colonial Empire" (Aberystwyth: Commonwealth Agricultural Bureaux, 1949. 10*s*.).

Factors affecting the incidence of erosion and its occurrence under different types of cultivation are discussed, and various forms of soil conservation described. Two main methods are recognized, one dependent on the use of earth structure, the other based on the use of cultural practices and living plant material. It is emphasized that soil conservation should not be regarded as a separate end, but rather

integrated into systems of husbandry capable of maintaining and enhancing fertility. Besides discussing the problem from the agricultural point of view, attention is also directed to the dangers of erosion around buildings, during construction of roads and in mining areas.

In order that measures for soil conservation shall be fully effective, communal action is called for, which may involve drastic modification in land utilization and agricultural practices. Some kind of legislation is therefore necessary. At present, the provisions for this vary widely in the different dependencies. In some it is built on the American model, whereas in others it is of a simpler form, or even based on the local rules of tribal or native authorities. A number of these provisions are described, those in operation in America being included for comparison.

CARE OF FISH IN TRAWLERS

THE importance of fish, a home-produced protein food, cannot be overstressed. To ensure that such a valuable but highly perishable food reaches the consumer as fresh and palatable as possible, care must be taken in its treatment on board the fishing vessel as well as after landing.

A new edition of "Food Investigation Leaflet No. 3, The Care of the Trawler's Fish" has recently been published for the Department of Scientific and Industrial Research by H.M. Stationery Office, price 4*d*. It is intended to help owners, skippers, mates and crews of trawlers and other vessels that catch 'white' fish to land their catches in the best possible condition. The leaflet, which has been revised and considerably extended, is concerned with the general practice of stowage in crushed ice.

The first section explains broadly and simply the scientific basis upon which the practical recommendations rest. Sea-water bacteria are the main agents of spoilage, bringing about the more striking undesirable changes in odour, flavour and appearance. These bacteria, simple types and harmless to man, are present in very considerable numbers on the outer surfaces, including the gills, of the gutted and washed, freshly caught fish, but not in the flesh. At ordinary temperatures, however, these bacteria multiply rapidly and invade the flesh, producing substances responsible for the stale, and later the putrid, odours and flavours associated with spoiling and spoiled fish, while the external surfaces become covered with dirty-coloured slime and lose their fresh bloom.

Practical recommendations are discussed in the second section. Chilling by stowage in crushed ice, although greatly retarding the activity of the bacteria, and hence spoilage, of the fish, does not stop it. Nevertheless, chilling is the most effective single factor in keeping fish fresh, and the greatest possible care should be taken to see that enough ice is used to chill the fish thoroughly and to keep it chilled until landing. In addition to controlling temperature, it is highly important to gut and wash the fish properly and to handle and stow it with care as soon as possible after catching, avoiding bruising, tearing or crushing. These principles hold good for all voyages, whether of a few days or of three weeks or even longer, as is now customary in the case of the distant-water vessels which provide more than half the fish supplies of Britain. The more fully they are observed, the better will be the general quality and acceptability of the fish.

A new feature of the leaflet is three appendixes. The first outlines the more important characteristics in the odour, appearance, texture, etc., of fresh and spoiled 'white' fish in both raw and cooked states. The second shows diagrammatically how, during stowage in ice for periods up to three weeks, the changing condition of the fish, as normally observed by the senses, is accompanied by increase in bacterial infection and in undesirable chemical changes in the flesh of the fish. The third appendix is a specimen short code of practice that might, it is suggested, be kept continuously before all concerned with the care of the fish.

The preservation of pelagic fish—namely, herring, pilchards and mackerel—is not dealt with in the pamphlet. So far as herring and pilchard are concerned, the problem of preservation scarcely arises on board, as the normal practice is to land the fish a few hours after they are caught. This, however, does not apply to the chief British mackerel fishery, in which the fish are often preserved on board in crushed ice for several days. In a highly perishable fish such as mackerel, great deterioration often takes place in a very short time. It would therefore seem worth while devoting some effort to devising for these fish, too, better methods of preservation on board and in land transit than are generally practised at present.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Monday, June 13

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Annual General Meeting.

Monday, June 13—Tuesday, June 14

INSTITUTION OF GAS ENGINEERS (at the Institution of Civil Engineers, Great George Street, London, S.W.1).—86th Annual General Meeting.

Tuesday, June 14

ZOOLOGICAL SOCIETY OF LONDON (at the Zoological Gardens, Regent's Park, London, N.W.8), at 5 p.m.—Scientific Papers.

Wednesday, June 15

PHYSICAL SOCIETY, COLOUR GROUP (at the Institute of Ophthalmology, Judd Street, London, W.C.1), at 4 p.m.—Dr. H. J. Plenderleith: "The History of Artists' Pigments".

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, London, S.W.7), at 5 p.m.—Scientific Papers.*

Wednesday, June 15—Friday, June 17

INTERNATIONAL GAS UNION (at the Institution of Civil Engineers, Great George Street, London, S.W.1)—Fourth International Gas Conference.

Thursday, June 16

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

INSTITUTION OF MINING AND METALLURGY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Discussion on "The Practical Postgraduate Training of Mining Engineers".

LONDON MATHEMATICAL SOCIETY (at the Royal Astronomical Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Prof. D. R. Hartree, F.R.S.: "Some Unsolved Problems of Numerical Analysis".

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26 Portland Place, London, W.1), at 7.30 p.m.—Annual General Meeting; Dr. R. V. Talice (Montevideo) will show a film dealing with Chagas' Disease.

Friday, June 17

BIOCHEMICAL SOCIETY (in the Department of Chemistry, The University, Nottingham), at 2 p.m.—Scientific Papers.

INSTITUTE OF NAVIGATION (at the Royal Geographical Society, 1 Kensington Gore, London, S.W.7), at 5 p.m.—Discussion on "Astronomical Navigation in the Air".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DIRECTOR OF RESEARCH in the Department of the Chief Development and Research Officer—The Chief Staff and Welfare Officer (Ref. F/EV.85), London Transport Executive, 55 Broadway, London, S.W.1 (June 17).

LECTURER IN BIOLOGY—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (June 18).

TEACHER IN THE SCIENCE DEPARTMENT, Northampton College of Technology—The Chief Education Officer, County Borough Education Committee, Springfield, Cliftonville, Northampton (June 18).

ASSISTANT PHYSICIST to the Hospital and to the Radiotherapy Department—The Clerk to the Governors, St. Bartholomew's Hospital, London, E.C.1, endorsed 'Physicist' (June 18).

SENIOR ASSISTANT, and a LECTURER with special responsibility, IN THE DEPARTMENT OF CHEMISTRY, and a LECTURER IN MATHEMATICS—The Principal, Central Technical College, Suffolk Street, Birmingham 1 (June 18).

LECTURER IN PHYSICS, for classes from Intermediate to B.Sc. Special standard—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17 (June 18).

ASSISTANT LECTURER (Grade III) IN GEOGRAPHY—The Secretary, The University, Birmingham 3 (June 18).

PHYSICISTS and CIVIL ENGINEERS at a Ministry of Supply Research Establishment in Essex, to study effect of explosives on concrete buildings and structures—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting A.138/49A (June 25).

ASSISTANT LECTURERS (2) IN THE DEPARTMENT OF ORGANIC CHEMISTRY—The Registrar, The University, Liverpool (June 25).

LECTURER or ASSISTANT LECTURER IN THE DEPARTMENT OF BIOCHEMISTRY—The Registrar, The University, Sheffield (June 25).

POMOLOGISTS (2), a PLANT PHYSIOLOGIST, a CHEMIST IN DOMESTIC FRUIT AND VEGETABLE PRESERVATION SECTION, a CHEMIST IN CIDER SECTION, a MICROBIOLOGIST IN CIDER SECTION, and a WILLOW OFFICER for research and advisory duties, in the Department of Agriculture and Horticulture, Long Ashton—The Secretary and Registrar, The University, Bristol (June 27).

LECTURER IN PATHOLOGY in the University of Queensland—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (June 30).

PRINCIPAL OF THE POLYTECHNIC—The Clerk to the Governing Body, Chelsea Polytechnic, Manresa Road, London, S.W.3 (June 30).

TECHNICIAN FOR THE CLINICAL DEPARTMENT of the Medical School—The Dean's Office, School of Medicine, The University, Leeds 2 (June 30).

DEMONSTRATOR IN GEOGRAPHY—The Secretary, University of Durham, 38 North Bailey, Durham (June 30).

LECTURER IN MATHEMATICS in University College, Dundee—The Secretary, The University, St. Andrews (June 30).

SCIENTIFIC OFFICERS (4) for the Soil Survey of Scotland, a SCIENTIFIC OFFICER for studies in Plant Physiology, a SCIENTIFIC OFFICER for Radioactive studies, a SCIENTIFIC OFFICER in the Department of Soil Fertility, and an EXPERIMENTAL OFFICER as an Analyst in the Department of Soil Fertility—The Secretary, Macaulay Institute for Soil Research, Craigiebuckler, Aberdeen (June 30).

UNIVERSITY DEMONSTRATORS IN AGRICULTURE, SOIL SCIENCE, AGRICULTURAL BOTANY, AGRICULTURAL MYCOLOGY, AGRICULTURAL ENTOMOLOGY, and an ASSISTANT in RESEARCH IN AGRICULTURAL ECONOMICS—The Secretary, School of Agriculture, Cambridge (June 30).

SENIOR RESEARCH OFFICER-CHEMIST, and a RESEARCH OFFICER-CHEMIST, in the Paint Industries Research Institute (University of Natal), Durban—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (June 30).

RESEARCH DEMONSTRATOR IN BOTANY AND ZOOLOGY—The Registrar, University College, Singleton Park, Swansea (July 2).

LECTURER IN CIVIL ENGINEERING, and an ASSISTANT LECTURER IN MATHEMATICS—The Registrar, The University, Leeds 2 (July 9).

RESEARCH SOIL CHEMIST—The Secretary and Registrar, University College of North Wales, Bangor (July 9).

ASSISTANT LECTURER or LECTURER IN PHYSICS—The Registrar, The University, Leeds 2 (July 9).

SENIOR LECTURER IN PHYSICS, specializing in Nuclear Physics, at Auckland University College, New Zealand—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (Auckland, July 15).

SENIOR LECTURER IN ELECTRICAL ENGINEERING (Power and/or Machines) in the University of Melbourne—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (July 15).

LECTURERS (2) IN THE DEPARTMENT OF METEOROLOGY—The Secretary, Imperial College of Science and Technology, South Kensington, London, S.W.7 (July 15).

MATHEMATICAL ASSISTANT (Lecturer or Assistant Lecturer grade) for work in connexion with the Automatic High Speed Computing Machine—The Registrar, The University, Manchester 13 (July 20).

ASSISTANT LECTURERS (2) IN ENGINEERING—The Registrar, The University, Manchester 13 (July 21).

LECTURER IN FORESTRY—The Secretary, The University, Aberdeen (July 21).

PROFESSOR OF BOTANY at the University of the Witwatersrand, Johannesburg—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (July 30).

I.C.I. FELLOWSHIP for research in CHEMISTRY or PHYSICS (or a related subject), tenable at Durham or Newcastle—The Registrar, University Office, 46 North Bailey, Durham (July 30).

SENIOR LECTURER IN MECHANICAL ENGINEERING in the University of Melbourne—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (July 31).

TECHNICIAN IN THE DEPARTMENT OF BACTERIOLOGY—The Superintendent, Royal Infirmary, Sheffield 6.

SENIOR ASSISTANT IN PHYSICS—The Principal, Derby Technical College, Normanton Road, Derby.

EXTENSION LECTURER (with a good honours degree and qualified to teach Natural Science, particularly Biology)—The Secretary, Oxford University Delegacy for Extra Mural Studies, 7 Wellington Square, Oxford.

GRADUATE RESEARCH WORKER in the Electron Microscope Laboratory—The Director, National Institute for Medical Research, Hampstead, London, N.W.3.

CHEMIST to take charge of research work (at present being carried out in the Department of Textile Industries, Leeds University)—The Secretary, British Brush Manufacturers' Research Association, Ltd., 80 Coleman Street, London, E.C.2.

LECTURER IN THE DEPARTMENT OF PHYSICS, and a SENIOR ASSISTANT in charge of BIOLOGY—The Principal, Technical College, Queen Street South, Huddersfield.

PHYSICIST IN THE RADIOTHERAPY CENTRE—The Secretary to the United Leeds Hospitals, General Infirmary, Leeds.

ASSISTANT LECTURER AND DEMONSTRATOR IN BACTERIOLOGY—The Secretary, King's College of Household and Social Science, Campden Hill Road, London, W.8.

JUNIOR ASSISTANT PHYSICIST—The Secretary, Bristol Royal Hospital, Guinea Street, Bristol 1.

BIOCHEMIST (non-medical)—The Director of the Pathological Laboratory, Coventry and Warwickshire Hospital, Coventry.

ASSISTANT PROFESSOR OF BIOCHEMISTRY—The Dean of Medicine, University of Alberta, Edmonton, Canada.

RESEARCH SCHOLARSHIPS (2)—The Principal, Technical College, Bradford.

RESEARCH FELLOWSHIPS (2) IN PHYSICS—Dr. G. M. Shrum, Head of the Department of Physics, University of British Columbia, Vancouver, B.C., Canada.

LECTURER IN RUBBER TECHNOLOGY—The Clerk, National College of Rubber Technology, Northern Polytechnic, Holloway Road, London, N.7.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Smoke Abatement Society. Proceedings of the Cheltenham Conference, 29th September to 1st October, 1948. Pp. 66. (London: National Smoke Abatement Society, 1949.) [142]

Air Ministry: Meteorological Office. Geophysical Memoirs, No. 80: Hourly Ranges of the Magnetic Elements, during the Polar Year 1932–3, at the Observatories of Lerwick and Eskdalemuir. With a Discussion by F. E. Dixon. (M.O.419h.) Pp. 64. (London: H.M. Stationery Office, 1949.) 5*s*. net. [142]

B.I.O.S. Overall Report No. 19: The Photographic Industry in Germany during the Period 1939–1945. By W. H. Dimsdale. Pp. 24. (London: H.M. Stationery Office, 1949.) 6*d*. net. [142]

Sugars and Bacteria: the Use of Carbohydrates in the Study of Bacteria and certain closely related Micro-organisms and in Clinical Tests. Pp. 36. (Ashton-under-Lyne: Thomas Kerfoot and Co., Ltd., 1949.) [172]

Some Aspects of Education in the U.S.A.: being a Report on an Educational Visit to the United States of America during the Summer of 1948. By Dr. H. Lowery. Pp. iv+48. (London: South-West Essex Technical College and School of Art, 1949.) [13]

Oxford University Institute of Statistics. Changes in the Cost-of-Living and the Distribution of Income since 1938. By Dudley Seers. Pp. 84. (Oxford: Basil Blackwell, 1949.) 6*s*. net. [13]

Air Ministry: Meteorological Office. Cloud Forms according to the International Classification. (M.O.233.) Sixth edition. Pp. 12+20 plates. (London: H.M. Stationery Office, 1949.) 1*s*. 3*d*. net. [13]

Department of Scientific and Industrial Research: Chemical Research Laboratory. Safety Measures in Chemical Laboratories. Pp. ii+22. (London: H.M. Stationery Office, 1949.) 6*d*. net. [13]

B.I.O.S. Overall Report No. 8: Rotating Wing Activities in Germany during the Period 1939–1945. By Capt. R. N. Liptrot. Pp. 76+15 plates. 3*s*. net. B.I.O.S. Overall Report No. 18: The Fighting Equipment and Methods in Germany during the Period 1939–1945. Prepared by J. F. Fry. Pp. 24. 6*d*. net. (London: H.M. Stationery Office, 1949.) [13]

Other Countries

Annals of the New York Academy of Sciences. Vol. 50, Art. 5: Thyroid Function as disclosed by Newer Methods of Study. By J. H. Means, A. Albert, E. B. Astwood, I. L. Chaikoff, E. W. Dempsey, E. DeRobertis, E. D. Goldsmith, C. P. Leblond, D. A. McGinty, R. W. Rawson, E. P. Reinecke, W. T. Salter and A. Taurog. Pp. 279–508. (New York: New York Academy of Sciences, 1949.) 3 dollars. [13]

Commonwealth of Australia: Council for Scientific and Industrial Research. Aeronautical Research Report ACA–40: A New Theory for the Strength of Wooden Box Beams. By J. R. M. Radok, J. P. G. Silberstein and H. A. Wills. Pp. 37. (Melbourne: Government Printer, 1948.) [13]

ISI Bulletin. (Published quarterly.) Vol. 1, No. 1, January 1949. Pp. 36. (New Delhi: Indian Standards Institution, 1949.) 1.4 rupees, 2*s*.; annual subscription, 4 rupees, 6*s*. [13]

Transactions of the National Institute of Sciences of India. Vol. 3, No. 1: On Nuclear Energetics and β-Activity, Part 2: The Groups $I=7$ to $I=20$. By Dr. Ajitkumar Saha, Samaresdranath Ghoshal and Sudhansu Das. Pp. 66. (New Delhi: National Institute of Sciences of India, 1948.) 11 rupees. [13]

Fundacion Lucas Sierra, Hospital de Vina del Mar. Jornadas clinicas de verano 1948. Pp. 434. (Vina del Mar: Hospital de Vina del Mar, 1948.) [13]